

SCIENCE

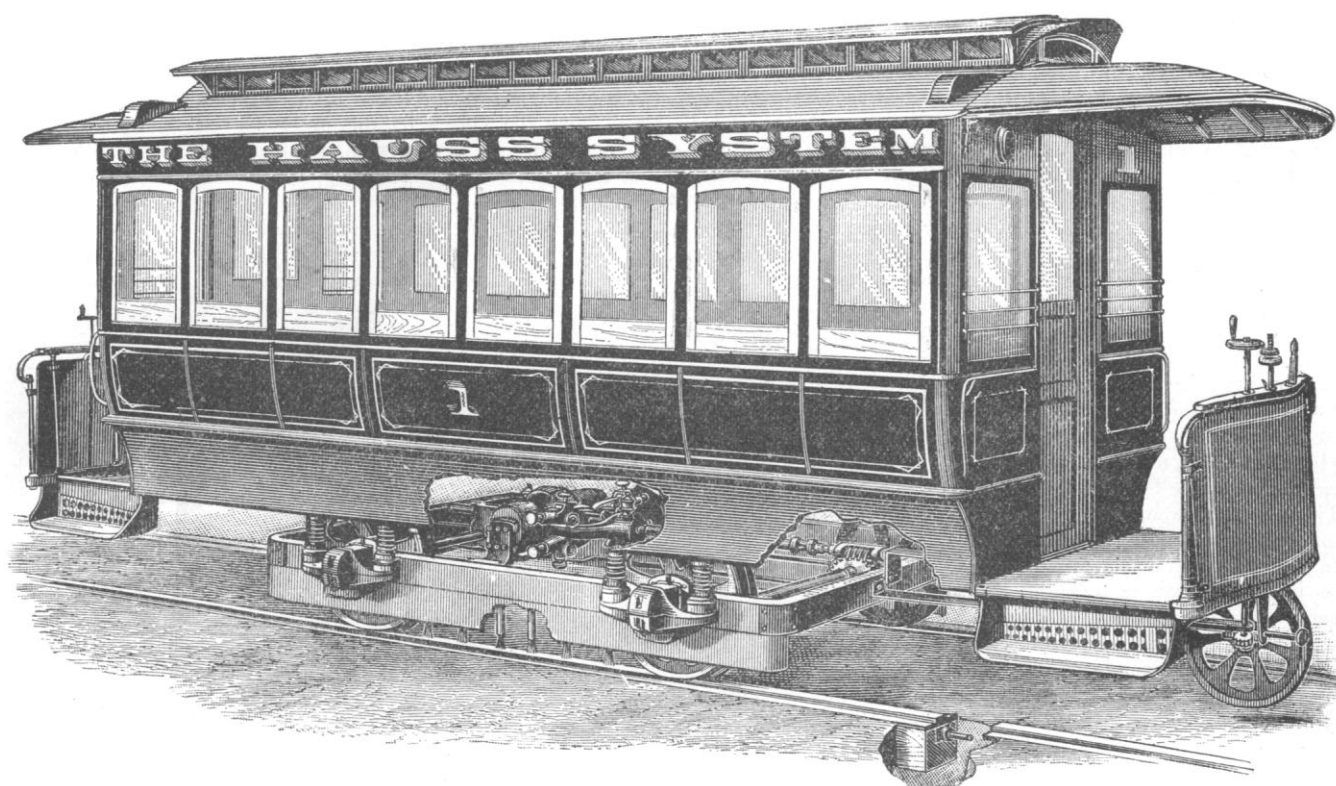
FRIDAY, DECEMBER 21, 1888.

THE HAUSS ELECTRIC RAILWAY.

ALTHOUGH that which has been accomplished within the past ten years in the applications of electricity to the arts of civilization affords a never-failing theme of interesting comment, it is more than probable that we have really only witnessed thus far the beginnings of its possible applications. We may anticipate, from the varied forms in which electricity will ultimately be applied for the transmission of power, results even more remarkable than those

something that no one disputes; and the eagerness with which intelligent people of all occupations follow the details of every new experiment having this for its objective point, affords the best evidence that the right method will receive a warm and unanimous welcome when it makes its title clear to the claim.

The conditions which an electrically operated railway in the streets of a city must fulfil are difficult of attainment. It must be entirely free from danger; it must be simple in construction and operation; and it must be an economical system in respect of first cost, maintenance, and operation. An additional point will be gained if a system of this kind could be devised by which the rolling stock of the present tramway companies could be utilized. The



THE HAUSS SYSTEM OF ELECTRICAL TRACTION.

which have followed its application in the field of illumination. It is well established that the energy of the electric current may be conducted, with comparatively little loss, over great distances; and the practical possibilities which this fact suggests of employing this agent as an advantageous substitute for steam in the production of motive power are fully appreciated by the army of able and ingenious inventors who are directing their energies to the practical side of electrical science. It is gratifying to know, also, by the admissions of so eminent an electrician as Professor Ayrton, that in this direction American electrical engineers have advanced considerably beyond their European brethren; for, while we have thousands of electric motors driving machinery of various kinds in this country, they are, with a few notable exceptions, practically unknown in Europe.

The most interesting and important of the problems involving the utilization of electricity for the transmission of energy is that of the electric railway. The successful solution of this problem, it is safe to say, will prove a great blessing to our cities in definitely settling the question of rapid transit. That sooner or later a method of electric transmission for this important service will be found, is

system that shall most fully realize these conditions will have successfully solved the problem of the electric railway for city service.

We have lately had the opportunity of examining and witnessing the operation of a system of electric railway for which claims of unusual merit are made. It is the Hauss electric railway, controlled by the Hauss Electric Company, and we shall devote some space to the consideration of its merits. As these may best be made conspicuous by comparison, we may properly consider the features of the several electric railway systems now in use.

The various systems now before the public may be enumerated as follows: first, the overhead system; second, the third-rail system; third, the use of the two rails as conductors; fourth, underground conduits; fifth, storage-battery; sixth, the Hauss insulated, sectional, underground system.

Respecting the system employing an overhead conductor, it may be said that its characteristic feature—the necessity of employing lines of posts and wires strung overhead—is an objection of the most serious character, which is practically prohibitive of its use in the built-up sections of cities, leaving out of the question the

serious troubles encountered in switching and crossing where many cars are used.

The third-rail system has in many cases been discarded, on account of the danger of receiving shocks to which persons and animals are exposed in crossing the rails, and on account of the great loss by leakage due to the extreme difficulty experienced in maintaining proper insulation.

The system using the rails as conductors has been discarded, because of the same objections that have just been urged against the third-rail system. The objections to the underground conduit system are the great first cost; the necessity and the expense of tearing up the streets, which in many cases prohibits its adoption; and the necessity of providing for its perfect drainage, which, in connection with the serious troubles in maintaining insulation, greatly adds to the cost of its maintenance and the running expenses.

The storage-battery plan, at first thought, would seem to be the ideal system. It dispenses with the necessity of a continuous conductor, the electrical generator and motive power are all contained within the car, and there is apparently an entire absence of any possibility of danger to passengers. These favorable anticipations would be justified were it once demonstrated that a storage-battery had been devised that was economical of power, of reasonable weight, and durable in service. Thus far, however, the best storage-battery that has been devised is very wasteful as a source of motive power, yielding at most but forty per cent of the power applied, excessively heavy and bulky, making it necessary to carry about three times the load of an ordinary car, and requiring a special car to be built to provide the necessary space beneath the seats to receive the batteries, — a matter of very notable importance, since it prohibits the use of the rolling stock of the surface roads without considerable cost for alterations. Furthermore, the storage-battery, as thus far developed, has a life of only two years of constant service, and it is subject to the danger of short-circuiting, which at once destroys its usefulness. Whether any or all of these deficiencies, which at present seriously interfere with its usefulness, may be remedied in the future, is a question which time alone can determine. It is sufficient for our present purpose to know that the storage-battery, in the best forms of to-day, is seriously handicapped by reason of these objectionable features.

The construction and mode of operation of the Hauss system will be understood from the following explanations: —

In this system an insulated wire is used, covered with rubber and other material known to be highly efficient in the case of underground electric-light wires. This wire is placed in a groove in the stringer underneath one of the rails, and is passed through metallic pockets, which are also placed underneath the rail. In order to obtain additional insulation, the stringer is coated with asphaltum. The metallic pockets are placed beneath the rail having the grooved stringer carrying the line-wire. The rails on this side are made in sections, each twelve feet long, each section being insulated from adjacent sections. When the car passes over the rail, contact is made with the wire in the pocket, and the current is collected by means of guard-brushes and the wheels. The entire length of the track is dead, and the only portion which is charged is a space twelve feet long directly under the car. When the car leaves one twelve-foot section, this section immediately becomes dead, and the next section over which the car is then passing becomes charged. There is at no time any portion of the track charged except that portion directly under the car, thus not only insuring against all danger to persons or animals, but also insuring efficient insulation along the entire route, and preventing a heavy leakage of current. The current is conveyed from the guard-brushes and the wheels to the motor, and through the other rail to the ground.

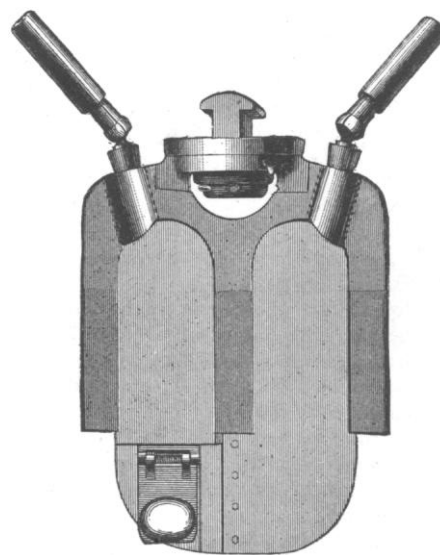
The speed or direction of the motor can be controlled from either end of the car. The motor is built as light as is consistent with the best electric results (a twenty-horse motor, weighing one thousand pounds), and the armature is run at a very moderate speed. The efficiency of the motor is affirmed to range, by actual test, at about ninety-five to ninety-eight per cent. The power is applied directly to the axles of the car by means of a worm and worm-gear, the latter being placed on each of the axles, and the worm connected directly to the armature shaft and provided with two ball-and-socket joints, to compensate for any slight derangement in

the relations between the motor and the shafts. The motor is bolted to a frame hung on the axles of the car, and fastened rigidly to the journal-boxes. The springs rest on the journal-boxes, and support the body of the car. The motor and truck are entirely independent of the car-body, and have no connection therewith. The motor can be geared so as to run the car ten or more miles an hour, and, as we witnessed at the trial of the system, can be perfectly controlled from the slowest movement up to full speed, and instantly stopped or reversed, if necessary, without injury to the machinery. No hand-brakes are required with this system, as the wheels are automatically locked when the armature ceases to revolve. In going down grade, there is no danger of the operator losing control of the car, and no possibility of the car running away. Another feature introduced on the car is a fifth wheel, shown suspended at the front end, which can be let down, and by means of which the front end of the car can be jacked up. When thus resting on three wheels, the car can be led around any obstruction and brought back to the track, connection with the track-conductor being temporarily made with flexible conductors. By this system the cars are able to leave the track, to go around a breakdown or an obstruction, to go over fire-hose when stretched across the track, or to cross over and take the back track. Finally, there is not an inch of room required for passengers that is used, and not a sign to denote the use of electricity in the propelling of the car to be seen above the floor. By this system, it is claimed, the cost of running is brought lower than has been possible with any other thus far devised, and the claim appears to be based on reasonable grounds.

The simplicity of the motive mechanism is such as to insure the minimum of trouble in operation; and the entire system, in respect of economy of construction, maintenance and running, and absolute safety, appears to have eminent merits.

THE CONDUIT SYSTEM OF ELECTRIC RAILWAYS.

AMONG all the different types of motors which have been pressing their respective claims upon the attention of the public during the last few years, there is none which can compare with the electric motor in its efficiency, its adaptability to all sorts of work, and its practicability as a means for the distribution of power from a

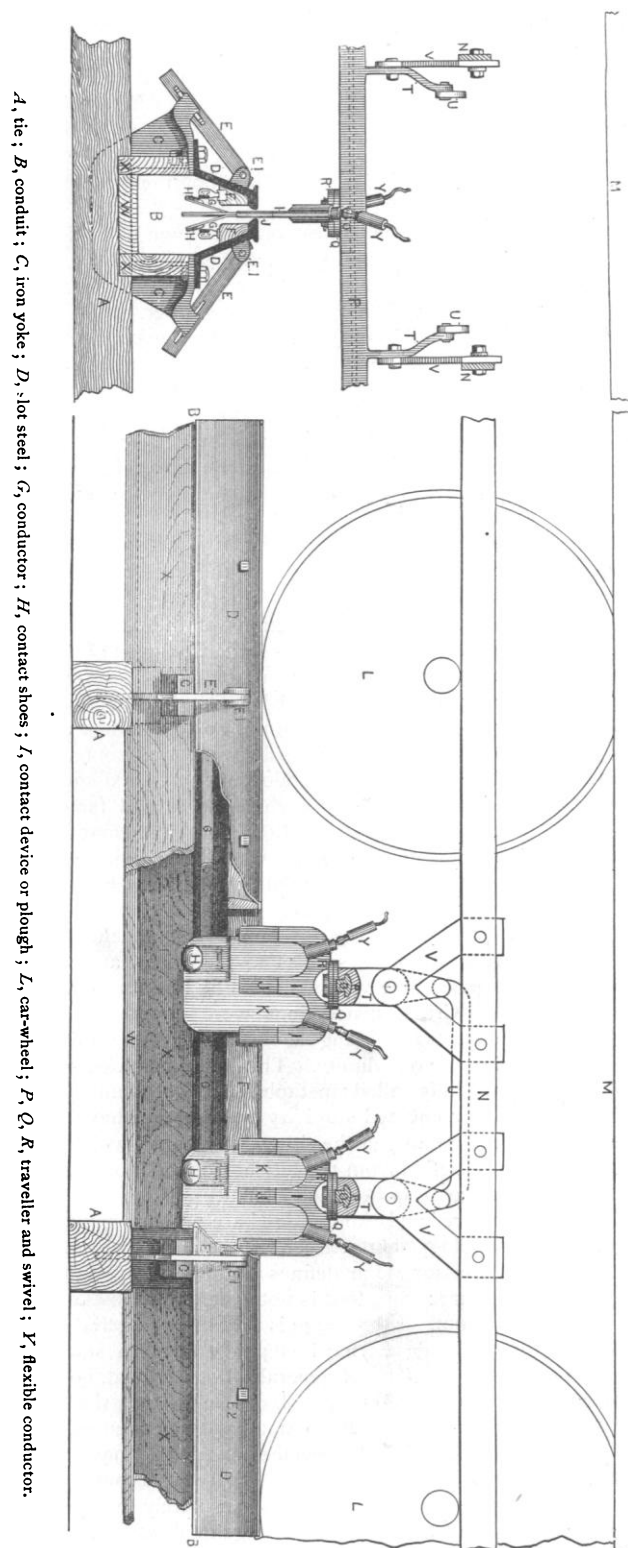


CONTACT DEVICE.

central station at a moderate expense. The number of electric motors now in every-day operation, and the extended range of the uses to which they are put, are matters furnishing constant surprise to all who are unpossessed of the latest information on these points.

One of the most interesting of the applications of the electric motor is found in the electrically propelled street-car of to-day which has already created a revolution in the field of locomotion and which promises in the near future to be as commonplace an

familiar as the horse-car now is. In this system the conductors are necessarily bared throughout their entire length, and must be protected both for the safety and convenience of the public and also to prevent injury to the conductors themselves. These requirements are fully satisfied by the underground conduit, which promises to be an indispensable element upon all urban lines.



This system has been developed by the Bentley-Knight Electric Railway Company of New York City, who claim to control by patented rights all practicable methods of locating the supply conductors in a conduit, and who, however this may be, have built the only roads operating on this plan. Either between or outside of the track-rails is laid a conduit about fifteen inches in depth and

ten inches in width, consisting of iron yokes set up from three to five feet apart, and slot steels bolted thereto, leaving an opening at the surface of the street of only about five-eighths of an inch. The direct and return supply conductors, consisting of copper bars united by expansion joints, are supported by suitable insulators in the upper part of the conduit, where they are out of the way of any slush and dirt which may collect therein. These conductors are placed opposite each other, and are connected in circuit with the dynamos at the central station. The car carries a plough or contact device, which extends down through the slot into the conduit, and has two contact-shoes insulated from each other, which rub against the two line-conductors. Flexible conductors in circuit with the two shoes extend up to the car, and are in circuit with the terminals of the propelling motor; so that, as the car travels along the track, the two housed conductors are constantly connected through a travelling loop circuit supplying the motor with current.

The shank of the plough is narrower than the slot, and the contact-shoes can be folded into line therewith, so that the entire plough can be inserted or moved from the conduit at will; and accidental breaking of the plough is guarded against by providing a spring catch normally holding the plough in place, but adapted to give way should any accidental obstruction be struck. In order to compensate for any curves or irregularities in the line of the slot, a transverse guide is provided upon the vehicle, and a traveller at the upper end of the plough moves freely along this guide, while swivelling or other jointed connections may be employed when found desirable. The car is propelled by either one or two motors of about fifteen horse-power, which are generally placed underneath the car-body, and centred around the axles, to which they are connected through intermediate speed-reducing gearing. The usual brakes are provided for stopping the car, while circuit switches and resistances control the speed and power of the motors with all the precision and nicety of which steam-motors are capable.

From this description the essential features of construction in the conduit system, as well as the mode of their operation, will be readily understood, but many questions touching upon the practical working of the system will suggest themselves to those interested in it as a commercial enterprise: Will the conduit become filled with dirt or with snow? Can the necessary insulation of the underground wires be maintained? Will the car have sufficient traction? What will happen if the car runs off the track? All these objections have been anticipated, and it is found that the satisfactory operation of the conduit road built by the Bentley-Knight Company at Allegheny City, Penn., demonstrates that they are groundless. This road, which is known as the Observatory Hill Passenger Railway, is about four miles in length, the conduit being employed for about one-fourth of this distance, and it has been in continuous operation since the first day of January, 1888. There are thirty-four curves on the line, not including turnouts and switches. The maximum grade is $9\frac{3}{4}\%$ feet in 100 feet, on a length of 400 feet, and this is on a reversed curve (radii 100 and 200 feet). The sharpest curve has a forty-foot radius on five-per-cent grade. Greater natural difficulties than these can scarcely be found on any street-railway in existence, and hence the successful working of the road during the severe snows and ice of the last winter is perhaps the best guaranty of the practicability of the system. Other conduit-roads are now under process of construction by the same company, noticeable among which are one of over three miles in length, contracted for by the West End Railway Company of Boston, and the Fulton Street Road of New York City. The progress of these roads will be watched with interest.

That for the West End Company in Boston is just completed, and will be put into operation in a few weeks, and thoroughly tested.

PHILOSOPHY AND SPECIALTIES.

ON Saturday evening, Dec. 8, the annual address of the retiring president of the Philosophical Society of Washington, Col. Garrick Mallery, U.S.A., was delivered before a very large audience, composed not only of the members of the Philosophical Society, but of those of the Anthropological, Biological, Chemical, Geographic, and Woman's Anthropological Societies, whose attendance had been

invited. The subject was 'Philosophy and Specialties;' and in the publication of an abstract we are compelled to omit all the ornamentation.

Colonel Mallery said that only three centuries ago the chief seats of learning were successfully challenged by a scholastic knight-errant to a dispute on any subject and all subjects, or, as it was derisively phrased, "*de omnibus rebus et quibusdam aliis.*" In the days of the Admirable Crichton it was possible for one mind to grasp the total of existing knowledge, and this was because science had not yet risen above the misty horizon. The study of facts and their co-ordination had not supplanted the two most prominent schools depending severally upon revelation and intuition.

The quality of revelation prohibited discussion upon it even as an explanation of phenomena, but allowed of reasoning from it within the usual limits of orthodoxy to be decided by the physically, not mentally, strongest battalions. So all that once represented science was mythology, especially in its grand division of demonology.

An opposite scholastic system, prevalent in its time, started in the tenet that intuitions should decide on the nature of things and the perfect type of their origin, to be ascertained by man's own ideals, not from observed data. The examination of a sound mind in a sound body being difficult, he was then the greatest teacher who had most enormously tumefied his inner consciousness, and could exhibit its morbidity with the most pretentious diagnosis. Subject to this leadership in introspection, every man was his own universe. Though specimens of such effete concepts still survive in folios, they are not found in the working libraries of science.

When, therefore, there was no attention to facts as such, and knowledge was either a commentary on revelation or a ratiocination on self, it was not so difficult to know every thing. To-day the pretender to universal knowledge will be denounced as knowing nought. This judgment is carried to an extreme. Even the exceptional minds, whose multiplied facets scintillate brightness in diverse angles, are denied glory as light-bringers on each line.

This is necessary, for phenomena are infinite, and science must deal with all as observed. In the formulation of its induced laws, no compromise is admitted, as in politics or ethics. But this infinite is composed of the infinitesimal, — atoms, molecules, protoplasms, or whatever name may be invented by our ignorance, — and it is by the study of these minutiae that science exists. So this is the era of specialties. No freshly discovered fact is without its significance, and may in its relations solve the most obscure problems. The original investigator now must not only be a specialist, but must work in some subdivision of a specialty.

This was illustrated in several of the sciences, in the professions of law and medicine, and also in art. The recent progress of specialization was shown by the fact that nine years ago the Philosophical Society was the only scientific society in Washington, embracing all branches. Since then the Anthropological, Biological, Chemical, and Geographic were founded, and the Mathematical Section of the Philosophical Society established. An account of these, with their several functions, was given.

However essential division of labor, specialization, and analysis may be, they are nevertheless only means to the ultimate aim of generalization and integration, which constitute wisdom, and its construction is by synthesis.

Within the most circumscribed of specialties there must always be an attempt to reach law through details. The solution of a problem without application of it is like playing a game of solitaire where time and skill give no result. Mathematics, apart from their gymnastic training, would be useless if their integrals should remain meaningless. Each asserted fact must be tested by varied experiment, which often results in failure. The truth of to-day has sometimes been the paradox of yesterday, and may become the falsehood of to-morrow. Admitted facts must be compared with all other facts related to them. Confutation must be challenged. Without this process, science would be a jumble of inconsistent opinions, so that cavillers might have excuse for a jibe that whatever is not sense is science. While such testing and comparative discussion should exercise its function in each specialized society, it is yet more important that the results, as appearing to its specialists, should be examined with the greatest freedom by specialists

in other lines; and this examination is not only for further verification and comparison, but to extend the area of acquired science. Practically science is only the existing condition of human knowledge, which of necessity is incomplete; though its form, to be science, should not be a broken surface, but a series of steps by which greater heights are gained. For these reasons all specialties should be tried before a court of general jurisdiction, — an Areopagus. In course of time, doubtless, the press brings forth scattered judgments of such a universal tribunal; but a hand-to-hand contest must be more active and decisive than a protracted war, conducted by the discharge of heavy books at long range, or by the skirmishing shots of pamphleteers. If scientific association is to do the most good, some time and place for trial by battle should be provided, which cannot be done in any or in all of the specialized societies by their separate work.

The propriety of scientific contest on a common plane is readily illustrated by the yet undetermined controversy between geologists and physicists respecting the age of our earth. As neither side can yet speak without contradiction by the other, neither should speak except in the hearing of the other. A more popular illustration is in the historic fight between ordnance and engineers; that is, scientific attack by artillery or its equivalent, and material defence by fortifications or similar protection. In no systematized war department can either the officer of ordnance or of engineers be confided in, except when, after experiment satisfactory to his own corps, his demonstration shall overcome the corps of his complementary antagonist.

Thus by the interrelation and counteraction of specialties there is mutual correction, ascertainment of truth, and promulgation of law.

After discussing the work and functions of the American Association for the Advancement of Science, the Congress of American Physicians and Surgeons, and other organizations, the term 'philosophy' was more closely examined. The old 'philosophers,' while professing to seek the truth, did not do so, but asserted that they had it already, and that their sole work was to teach it to others. As before hinted, this philosophy was axiomatic, and closely connected with theology, by which forces and factors were postulated but not comprehended. Logic and mathematics do not detect errors in axioms and postulates when once admitted. Verities by common consent were adopted *a priori*, which verities, belonging to a low stage of culture, were universal errors, and therefore in accord with all existing reasoning. The teachers found it convenient to reason from the species to the genus, and from the particular to the general, by words instead of by ideas; that is, by verbal sophisms. Crude conceptions were employed to make words, which the elasticity of languages permitted, grammatic form and euphony being the only limits. This superannuated scholasticism has been generally called 'metaphysical,' but is more properly 'antiphysical.' Its combined stupidity and pretence have to some minds inflicted a stigma upon the title 'philosophy' which it arrogated. Modern re-action from the feticistic worship of this monstrous phantasm may have been too violent.

The terms 'science' and 'knowledge' are perhaps convertible in usage, as in etymology, but neither of them is synonymic with 'philosophy.' Professor Mach defines 'knowledge' as 'an expression of organic nature;' but that is not true, unless by knowledge he means true wisdom. Knowledge is the 'mere material of which wisdom builds.' Claude Bernard is partly right in stating that philosophy makes a specialty of generalizations. That, however, is measurably true also, as before stated, of each one of the sciences. Without proper synthesis, they do not exist as sciences, but are mere uncouth mosaics. Each special science must have a philosophic side, and the co-ordination of all of those sides constitutes philosophy in general. In this sense it is not merely the specialty of generalizations, but the generalization of generalizations. Without it the several sciences rest with no common bond, and do not form a synthetic and organic whole. Their fundamental hypotheses are liable to overthrow, because they are not criticised and revised by logical co-ordination. The method of science is to test hypothesis by experimentation and continued observation. From a sufficient number of results a proposition or law is induced, the authority of which increases with the number and weight of those results. It

is not a valid objection that generalizations, even obtained *a posteriori*, have often been erroneous. So much the greater necessity for their trial by a proper tribunal; for the end is to establish from particular facts a general law, which thereupon may be considered as a principal fact, explaining and showing the relations between the facts which it governs. This second course is deductive, in which the value of the conclusion is that of the premises. The collection of and proper deduction from, more strictly the application of, such principal facts or induced laws, is the domain of philosophy.

The vocabulary employed by an ecumenical society should be different from that proper to a specialty. It should be such as is understood by an audience of good general education. It is true that the actual operation and formulation of thought in many branches, notably chemistry and botany, besides mathematics, requires the elaborate technical language and symbols invented for them; and in all lines of study condensation and determination have demanded neologisms, which increase daily with new facts and thoughts. But workers with these newly fashioned terminologic tools become too fond of and dependent on them.

In the use of specialistic and coined terminology, not only pedantry may be observed, but the old juggle with words, in which pretended novelty is only mystification. Greek compounds are convenient as brands or labels, but do not make thought less, and often leave it more obscure. Polysyllables and water are bad, but polysyllables and mud are worse. Such obscuration of truth is a serious injury. From these views it must be admitted that philosophy, being broader than any science, — than all the sciences together, — cannot be limited by the formulation peculiar to any of them, and therefore its language should not adopt the terms of any, but use such as are generally understood and accepted.

This admission at once brings up the subject of style in its broadest scope. The prime requisite of style in philosophic as distinguished from specialistic writing is, that it should be clear to all; the second, that it should be attractive. It is not so easy to be clear; and Sheridan's phrase, "Easy writing's curs'd hard reading," is enforced by the confession of so great a thinker and writer as Charles Darwin. Style is not confined to vocabulary or ornamentation. It is the treatment which, by the mental work of presentation, the author putting himself in the place of the reader, enters into substance, and translates from his own mind to many minds. A large number of examples were given of the use of style well and ill, by scientific and non-scientific modern writers of English.

It is not proposed, however, to offer a disquisition on style. But as Wesley once protested, in words rendered more pungent by Elder Knapp, against "the Devil having all the best tunes," it is desired to enter a vigorous protest against fiction having all the best English. Two suggestions only will be ventured, both perhaps unexpected. The first is that poetry should be incorporated, not injected, into a scientific production. This does not renew the adjudicated claim of the imagination — "the vision and the faculty divine" — to scientific use, but refers to the manner of expression. Never let prose get into your poetry, but put all the poetry you can invoke into your prose. Molière's hero was astonished to learn that he had been talking prose all his life without knowing it; and, conversely, our best prose-writers on the heaviest subjects might find that the poetry in their prose was the secret of their success. This conception of poetry does not mean the evanescent prismatic tints on the bubbles of a scientist or scientulus, — whichever term may suit the diminutive pretender, — but the informing and vitalizing light, which not only refracts and reflects, but radiates from an original source. The spontaneous characterization of the highest order of prose writings is that they are full of light, fire, and life; and the term 'poet,' applied to their authors, shows its true etymology, — the maker.

The second plea is for the admission of wit and humor into scientific writing. No one, not even Sydney Smith's Scotchman, is willing to confess his imperception of humor. Nevertheless nature has not given it to every one; and to those to whom it is denied it is as the absence of a sixth sense, by which absence much happiness is lost. This enumeration of humor with the senses is scarcely forced, for man has been styled the 'laughing animal,' as best distinguishing him from other orders. Neither the grin of some

simians nor the cachinnation of the hyena, nor any similar demonstrations by other animals, represent human smiles and laughter. The deficiency may be compared with unappreciation of the arts in general; but the histrionic art is that on which there is least controversy. Every man who is in the normal possession of his senses appreciates perfect acting. Dr. Johnson suffered from bad vision and hearing, and therefore never could reconcile himself to the overwhelming success of his friend David Garrick as an actor. Translate his physical imperfections, while admitting his general judgment, into terms of humor, and it may be understood how many good and wise people fail to enjoy it. With them the dogma is naturally cherished that a witty man is always shallow. Sydney Smith, who knew whereof he spoke, says, "The moment an envious pedant sees any thing written with pleasantry, he comforts himself that it must be superficial." Many people admire sententious monotony, even if it be stupidity, and are shocked too much for their delicate nerves at the sudden presentation of an intellectual surprise. Yet what is more forcible? Is there any mode in which truth can be more strongly presented than by its humorous opposite? If the dry *reductio ad absurdum* is legitimate, how much better is it when laughter brings an echo! Laughter must be; therefore philosophy cannot ignore it.

Both science and philosophy are separated from literature by well-established boundaries. Passing by philosophy for the moment, the distinction between science and literature may be sharply drawn by recognizing that science deals with facts regardless of the vehicle of their expression. Literature, on the contrary, may disregard all facts as such, while occupied with reflection and sentiment; and in it the form of expression is essential. There is a literature of science and of all the sciences; but few scientific works can be embraced in literature, if only because of their defective form.

The favorite but not vallated domain of literature is æsthetics in its true meaning, — viz., that which is perceived or apprehended by the senses, but limited to what is desirable to be so apprehended, the beautiful (the Greek *το καλόν*), — and, even if the spirit of literature abandons this Elysian realm, the form cannot depart from it and live. Specimens of literature may properly be stigmatized as bad, — bad in tendency and effect, as in their influence upon morals, religion, politics, and the like; but literature cannot be bad in form, because, if its form is not æsthetically good, it is not literature at all. It has been asserted that in literature the substance is of little moment — only the form, the manner in which the things are written, and not the things. An argument can be made in support of this dictum. Even the utilitarian must admit that the struggle for perfection in language — comprising vocabulary and grammatic form — for itself alone has presented to both science and philosophy their vehicle, and has established for humanity its imperial distinction over the rest of living beings.

Some advocates of form *versus* substance might quote favorite passages of Emerson or Browning that cannot be understood, as is proved by so many diverse interpretations. But while æsthetic form is undoubtedly essential in literature, comprehensible thought must be there also. The smoothest iambics and most stately hexameters which exercise in Latin prosody the scholars of Eton and Harrow, technically styled 'nonsense verses,' are not literature.

It may seem bold to assert that literature should not meddle with science, when every novel brings into its machinery some scientific statement or discussion, and as fast as each new discovery appears it is seized upon by the romancer for his plot as a *deus ex machina*. But, if this employment is more than machinery or incident, the novel becomes a dilute treatise, and is not proper literary work.

A rough contradistinction may be outlined, that science deals with facts, the thoughts being secondary; literature with thoughts, the facts being secondary; but philosophy includes equally the facts and the thoughts relative to them. Science supplies food, but neither savor nor digestion; literature pleases the appetite; philosophy with appetite digests the food. Again: to science the language used is subordinate; to literature the language is paramount; to philosophy the language is essential, but not paramount.

It remains to offer the suggestion that philosophy should also be

regarded from the significance of its etymology, — the love of wisdom. Lessing said, that, if it were necessary to choose, he would prefer to have the love of truth to the possession of truth itself. By this paradox he meant to emphasize his desire for wisdom, not for repletion by facts and cold encyclopedic knowledge. The mere possession of truth, not strictly wisdom, may be that of a miser who hoards and does not circulate it to the common good; but the love of wisdom brings wisdom. "Be there a will, and wisdom finds a way." "Wisdom crieth aloud, she uttereth her voice in the streets," and it will be regarded. "So teach us to number our days that we may apply our hearts unto wisdom."

SCIENTIFIC NEWS IN WASHINGTON.

Causes of Configuration in Trees. — How Some Eskimo Measure. — A New Improved Freezing-Microtome.

Causes of Configuration in Trees.

THE influences under which a tree assumes one shape instead of another are obscure even to the students of vegetable dynamics. External forces are added to hereditary forces in every growth. The mechanical forces at work, affecting plants externally, are mainly gravity and atmospheric pressure (wind).

B. E. Fernow, chief of the forestry division of the national Department of Agriculture, recently read a paper setting forth some valuable observations.

The physiological forces are termed 'stimuli,' and produce reactions only on the growing tissue, and are characterized by the disproportionality between the external stimulus and the ultimate re-action. These forces work accidentally and occasionally, often changing the environment of an organ; and such alterations may occur by a change in the intensity or direction of the light, variation of temperature, instantaneous shocks, sudden pressure, etc. The capacity to re-act to these stimuli is called 'irritability,' the presence or absence of which is a sign of life or death.

The various parts of a plant re-act differently to the same stimulus, and according to their type of structure. The internal capacity of a part of an organ to re-act to external influences determines its external form and the direction of growth: thus radial structures are usually orthotrop (tending to place their axis toward the acting force), dorsiventral structures act plagiotropically (tending to place their axis obliquely or transverse to the direction of the acting force).

But there is also seen what may be termed a 'vicarious correlation' of the different structures, by which the development of one organ is changed in its direction by the development or lack of development of the other; thus, also, a plagiotropic organ becomes orthotrop. The most common example of this correlation is seen when the main axis is cut off, and a side-branch takes the orthotropic nature of the main axis.

The stimuli that effect changes of direction in various parts of plants — aside from accidental ones, like pressure, contact, moisture, heat — are mainly light and gravity; the re-action to light being termed 'heliotropism,' and that to gravity being 'geotropism.' In regard to the latter re-action, there appears to be a misapprehension as to the nature of gravitation, as usually accepted, and as stated by Sachs, Darwin, Wiesner, and others.

It seems illogical to assume that gravity, conceived to act everywhere and constantly, could be considered as determining the direction of the primary root vertically downward, of the secondary roots obliquely downward, and of the other classes of roots growing without reference to this always active force.

That the direction of the different parts is a resultant of several forces, among which gravity may be one, is hardly intimated by these writers; and the dominion of gravity is so forcibly stated that the occasional reference to modifying influences does not impress us as a necessary and important consideration.

The effects of heliotropic (light) stimulations are the opposite from those called 'geotropic,' or a bending toward the light. But the effect of light upon root-forming matter is to turn it away from the light; and upon shoot-forming matter, to turn it toward the light; while dorsiventral structures adjust themselves obliquely across the direction in which the light strikes the irritable organ. The latter behavior is highly important, and reveals the purpose of

this re-action, which results in the largest surface of chlorophyll-bearing cells being exposed to the light, and inducing the chemical changes upon which growth depends.

Intensity of light, however, may become injurious, and hence the presence in some plants (*Mimosa*) of an ability to change the position of the leaves with reference to the optimum light intensity. As the light is diffused equally in the atmosphere, a re-action is produced only by a difference in the amount of light which reaches the different sides of a growing part. The direction, then, of a branch, as far as it is dependent on the action of light, is in proportion to the difference of illumination of its parts; for a greater illumination on one side of a branch has the effect of increasing the cell-growth on the shaded side (hyponasty), and thus the more rapid lengthening of the shaded side results in a curvature and a new direction of the tip of the branch toward the light. The action of light on the roots is exactly opposite (epinasty); i.e., the illuminated part lengthens more rapidly, carrying the growing point away from the light.

Considering the action of the light on the normal development of the branch system, concludes Mr. Fernow, we can better understand how the direction of branches is changed from their original position to the one in which we find them in later life; and we can also understand that the typical branch system of trees must to some extent depend on the greater or less density of foliage. Thus less dense foliated trees should in general exhibit a more erect habit in their branches; while the shadiest foliage should give the most spreading branch system.

How Some Eskimo Measure.

The ape which (or perhaps whom) Mr. Romanes has succeeded in teaching to count five seems to tread closely on the heels of some of the races of men. In a paper on the Eskimo of Point Barrow, Mr. John Murdoch of the National Museum said, that, like the rest of those peoples, they ordinarily do not use numbers greater than five, but speak of six and all higher numbers as 'many.' Their real numbers are one, two, three, four, five, ten (which means the upper part of the body, namely, the number of digits on the upper extremities), fifteen (perhaps), and twenty (which means 'a man complete,' i.e., all his digits used up). These numbers are almost identical with those used in the other dialects, while the intermediate numbers are quite different, though expressed in a similar manner; that is to say, 'so many on the next hand or foot.'

With such clumsy numerals, arithmetical processes are practically impossible, though they practise a sort of crude addition, arriving at the number of a large series of objects by grouping them together in fives. In counting, the ordinal numerals are used. This is also the same as in the other dialects.

They originally had no standard of dimensions for space, but of late years have learned to use the fathom in trading for cloth, etc.

Time is measured by the sun and stars. For example: the star Arcturus is the seal-netters' timepiece. When he is in the east, dawn is near, and it is time to stop fishing. The year is divided into four seasons, — early winter, winter, early summer, and summer.

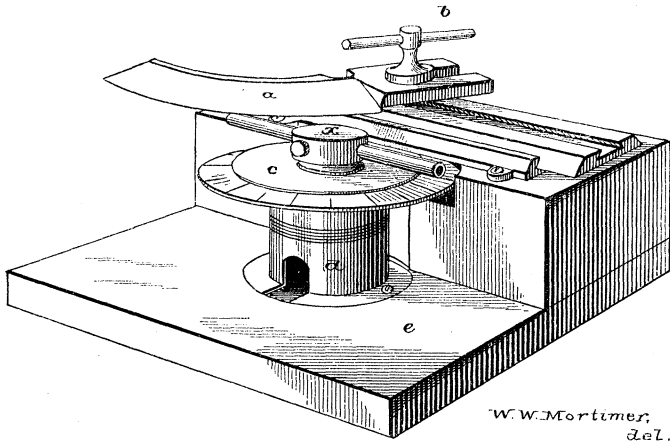
Nine lunar months are known by name. The rest of the year "there is no moon, only the sun." They begin to count the moons from the early autumn, the time when the women go off into the little tents to work on deer-skins. The first moon — roughly speaking, October — is "the time for working, i.e., sewing;" November, "the second time for sewing;" December, "the time for dancing" (this is the season of the great semi-dramatic festivals); January, "great cold," or "little sun" (in this moon the sun just re-appears at noon); February, "the time for starting" (on the winter deer-hunt); March, "the time for starting home;" April, "the time for making ready the boats" (for whaling); May, "the time for fowling;" and June, "the time for bringing forth young" (when the birds lay eggs).

They clearly distinguish "to-day," "yesterday," and "to-morrow;" but "day before yesterday" and "day after to-morrow" are the same; and beyond that, all is "some time ago" or "some time hence" (the same word), till it gets to be "long ago" or "by and by."

Then there are no dates in their past or future, except what has happened or is to happen.

Dr. Thomas Taylor's New Improved Freezing-Microtome, adapted to Three Methods of Section-Cutting.

Dr. Thomas Taylor of the Agricultural Department, who several years ago invented a microtome, which was described and illustrated in *Science*, gave the first public exhibition of a new microtome at the last meeting of the Microscopical Society of Washington. The following diagram and description will show the advantages claimed for it. It may also be added that it is simpler, and can be manufactured at much less cost, than the microtomes now generally in use; and, as those persons employed by the government are not allowed to patent inventions made in the line of the work they are engaged in, any microscopist in the country may make and use the instrument here described.



a, curved knife, adjustable at any angle; *b*, binding-screw; *c*, graduated disk, which revolves on stand (*d*) by means of a finely cut screw-thread; *e*, mahogany stand upon which the instrument is secured.

A cork with a central opening is fitted into a descending tube (one inch deep, by one and a half inches in diameter) in the centre of disk (*c*). Cork and tube revolve with the disk. In the central opening is fitted an ordinary stopper or cork, on top of which the object to be shaved may be secured by paraffine or wax.

In order to freeze objects, remove the central cork, and insert the hollow metal box (*x*), a prolongation of which fits into the hollow cork in disk (*c*). Two tubes of metal project from the freezing-box, — one to admit water, the other to allow it to flow out. The water is supplied and carried off by means of rubber tubing attached to the metal tubes, the terminal end of the rubber tube which carries off the water being contracted to control the flow.

In the use of ether as a means of freezing objects for the cutter, remove the plug in front of the freezing-box, and detach the rubber tubing. Apply ether in the usual manner.

ETHNOLOGY.

Tales from Venezuela.

DR. A. ERNST, who has done so much to increase our knowledge of Venezuelan ethnology, has collected a few popular tales, which are very interesting on account of their Tupi and Spanish affinities. The tales are entitled 'Tio Tigre and Tio Conejo' ('Uncle Tiger and Uncle Rabbit'), and all of them have for their subject the superiority of cunning and craft over sheer force. We give here translations of a few of these tales.

"Uncle Tiger had a field of splendid watermelons. He observed that somebody visited his field at night, and stole the melons: therefore he made a figure of a man of black wax, and placed it in the field. At night Uncle Rabbit came, and saw the figure. 'What are you doing there, you black man? Get away!' The figure did not reply. Then Uncle Rabbit went up to the black man and boxed his ears; but his right hand stuck to the wax. 'Let go my hand, or I'll box your other ear!' cried he. When he did so, his left hand also stuck to the wax. Then he knocked his head against the forehead of the figure: his head stuck to it. Then he worked with his hind-legs to get away: they also stuck to the wax, and Uncle Rabbit was caught. Early in the morning Uncle Tiger

came, and when he saw Uncle Rabbit, he cried, 'Oho! have we got the thief? Now I'll eat you!' — 'Wait a moment,' said Uncle Rabbit; 'set me free, and I will show you a pit in which two large deer have been caught. You had better eat those.' Uncle Tiger thought, 'Two large deer are better than Uncle Rabbit,' and he set him free. Uncle Rabbit led him to a deep pit, and said, 'Stoop down, and you will see the deer.' When Uncle Tiger did so, Uncle Rabbit pushed him from behind, and Uncle Tiger fell into the pit. Uncle Rabbit, however, ran away as fast as his legs would carry him."

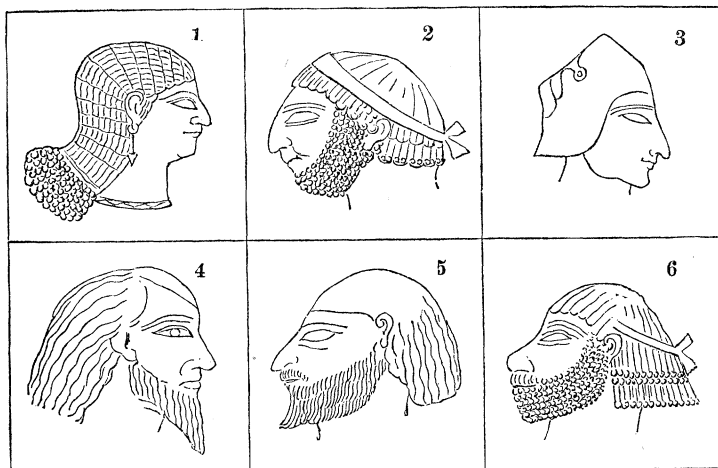
Here is another story: "Uncle Rabbit was very sad because he was so small. He went to God, and wanted to be made taller. God said, 'I will do so, but first bring me a coral snake, a wasp swarm, and a calabash filled with women's tears.' Uncle Rabbit started on his journey, and arrived in a forest where there were many snakes. Walking along there, he said, 'I bet there is room for him, I bet there is room for him!' A coral snake heard him, and asked what his speech meant. He replied, 'The wasps say that there is not room enough for you in this calabash, and I bet that you can get in there.' — 'We will see at once who is right,' said the snake, and crawled into the calabash. When he was in it, Uncle Rabbit at once put the stopper into the opening, and thus the snake was caught. Then he went on, and said, 'I bet there is room for them, I bet there is room for them.' The wasps heard him, and asked what his speech meant. 'Oh!' said Uncle Rabbit, 'the snake says there is not room enough for your swarm in this calabash, and I bet that all of you can get in there.' — 'We will see at once who is right,' said the wasps, and crawled into the calabash. When the whole swarm was in, Uncle Rabbit put the stopper into the opening, and thus the wasps were caught. He next went to a village, and when near the huts he began to cry and lament. Then all the women gathered, and asked the cause of his grief. 'Oh!' said Uncle Rabbit, 'why should I not cry and lament? The world is going to be destroyed to-day, and all of us will perish.' When the women heard this, they began to cry wofully, and Uncle Rabbit filled a calabash with their tears. Then he returned to God. When the latter saw the three calabashes with the snake, the wasps, and the tears, he said, 'Uncle Rabbit, you are more cunning than any one else. Why do you want to be taller? But as you wish it, I will at least make your ears larger.' Saying so, he pulled Uncle Rabbit's ears, and since that day they have remained long."

The Races of the Babylonian Empire.

In a recent number of the *Journal of the Anthropological Institute*, Mr. G. Bertin publishes an interesting study of the types of man found on Babylonian monuments. One of the most remarkable results of his researches is the proof that the Armenian race of these early times exhibits the same characteristics to be noticed in the modern Armenians (Fig. 3). This is the more remarkable from the fact that at this period the language spoken in Armenia, and illustrated by the inscriptions of Van, is totally different from Armenian, and linguistically connected with Akkadian and Media. Evidently the Armenian population has, in course of time, acquired a new language, while its physical characteristics survive. Dr. von Luschan has shown that the Turks and Greeks of Asia Minor are of the same Armenian type, and thus the great antiquity of the native population of this region is proved.

Conclusions derived from types represented on ancient monuments cannot be of the same value as craniological researches; the individuality of the artist, the conventionalism of art, and the object of the monument having a ruling influence upon the character of the representations. Captive enemies will not be represented in the same way as a victorious king and his allies. Nevertheless a variety of types may readily be recognized, as the artists undoubtedly represent typical individuals. A few figures from the plate accompanying Mr. Bertin's paper have been reproduced here. It will be noted that the faces are represented in profile, with eyes in full face. Figs. 2, 4, 5, and 6 are of peculiar interest. The persons represented resemble the types of figures on Assyrian monuments showing people of inferior condition. Fig. 2 is taken from an Assyrian monument. The head is small and round, the forehead low and slanting, the cheek-bones high, the lips thin, and the chin

retreating. In many of these figures a marked prognathism may be observed. The nose is often large, and does not appear to have ever been flat and wide, as among the Tatars; hair and beard are frizzy; the stature, short. In some parts of Babylonia this type seems to have formed the great mass of the population. According to Mr. Bertin's theory, this people was the 'ground race' of western Asia, and he goes so far as to identify it with the European prehistoric races, which are by many authors believed to be of Berber origin. He adds, "An important point to notice is that this race is everywhere found in an inferior social position, and it was equally so in the remotest age. Nowhere did it rise to the rank of a dominating or ruling race, but everywhere it accepted the yoke of the conquering tribe invading its land. It is the race of the land, and accepts every new master with a passive obedience. This explains why this race has no language of its own, for it accepts willingly



that of its masters." The author believes that this people was conquered by Akkadians and by Semites, and that the mixture of these races, with the addition of some Armenian blood, resulted in a population showing the various types found on the monuments.

The study of the west Asiatic and Egyptian monuments from an anthropological and philological point of view has recently yielded most interesting results, and opened entirely new views of the early history of the ancient world. The intercourse between the various peoples, and their mutual influence upon each other, were so important, that a comprehensive and comparative study of all these numerous peoples is necessary to reach satisfactory results. The theories of Mr. Bertin are suggestive, and well worth a careful consideration; but they must be verified by a comparative study of the monuments of other races, and, what is still more important, by exact anthropometric researches.

ELECTRICAL NEWS.

Submarine Boats.

THERE are few books that have been read with so much pleasure by young and old as Jules Verne's 'Twenty Thousand Leagues under the Sea.' The submarine boat 'Nautilus,' propelled by electric motors, — very complicated ones, if the writer remembers the picture correctly, — the electricity furnished by powerful batteries, was able to move at a wonderful speed beneath the ocean at the will of her mysterious commander.

The folly of one generation is the wisdom of the next, and to-day we are in all seriousness trying to faintly rival the vessel of Captain Nemo. The boats that are being built are for torpedo purposes, and are neither large, nor do they attain a very high speed, nor can they remain long beneath the water; but we look for a steady improvement in their performance, and we believe that some day such vessels will be of practical use to mankind. The great difficulty in submarine propulsion is the obtaining of some propelling agent that can be used beneath the water. Hand-power was first tried, and later compressed air and carbonic acid have been employed. For automatic torpedoes, such as the Whitehead or Lay, the two latter agents are fairly successful, but the amount of energy

that can be practically stored by either means is too small to be of use in a real submarine boat.

The history of the early experiments in submarine navigation is the history of disaster. There are stories of partial successes, but the sequel is usually tragic. A successful submarine boat is said to have been made by a Chicago shoemaker, who was in the habit of going out in it and spending his afternoons in the bottom of the lake. One evening he failed to return, and, as he had not communicated the plans of his boat to any one, his experience is lost to us. The writer remembers, in the war between Chili and Peru, that a submarine boat was built by the latter government to destroy the Chilean fleet, at that time blockading Callao. It was to have been run by compressed air, and was calculated to attain a speed of four miles an hour. An unfortunate miscalculation resulted in the weight of the vessel being greater than her displacement; and, on being launched, she immediately went to the bottom, where, owing to the characteristics of her builders, she was allowed to remain. During the late war a number of experiments were tried with submarine torpedo-boats; but, excepting in one case, they resulted in failure.

There is no inherent impossibility in navigating boats beneath the surface for any length of time. The atmosphere can be purified and its oxygen renewed by chemical means, and the depth that can be attained depends only on the ability of the boat to resist the enormous pressures to which it is subjected at any considerable depth. The distance beneath the surface can be regulated in a number of ways, for the density of the water is practically the same at any depth. The only drawback has been in the difficulty of obtaining power. In the last few years electricity has promised to remedy this.

The latest and largest submarine boats are being tried in Toulon and at San Fernando respectively. Let us first describe the French boat, the 'Gymnote.' She is driven by an electro-motor coupled directly to the armature shaft, and supplied with electricity from storage-batteries. The motor absorbs 52 electrical horse-power at 280 revolutions a minute. The total weight of the motor is about two tons. The electric energy is furnished by a battery of 564 storage-cells of the Commelin-Desmaures-Bailhache type, described in this journal (No. 305). Each of the cells weighs about forty pounds, making over ten tons for the weight of the battery. They have furnished 58 horse-power for four hours. The experiments made on this set of cells show that to store one horse-power of energy requires about eighty pounds, while energy can be taken out from them at the rate of a horse-power for four hundred pounds. The 'Gymnote' has been tested in the roadstead of Toulon to determine her behavior, but so far the experiments have only shown how long she can safely remain beneath the water. Half an hour is the longest time as yet, but it is hoped that the time of submersion will be considerably increased. What the speed of this vessel will be, how easily she can be controlled, and what depth she can safely reach, are questions yet to be determined.

The boat being tested at San Fernando, 'Le Peral,' has been constructed from the designs of Lieut. Isaac Peral of the Spanish Navy. It is about seventy-two feet long, by nine feet and a half at its greatest diameter. It is driven by five electro-motors, — two of twenty, three of nine horse-power, — furnished with current from 600 cells of storage-battery. No experiments have been made on this boat, but it is calculated that she will have a speed of twelve knots at the surface, and of ten knots when half submerged. It is also calculated that she can remain below the water for two hours without requiring a fresh supply of air.

Germany is not behindhand in these experiments, and has built at Kiel a boat one hundred and twelve feet long. Its immersion is regulated by two vertical screws driven by a six-horse-power motor. What the propelling power is, and what its performance may be, we have no data that will enable us to guess; but that the motive power is furnished by electricity there can be little doubt.

These three boats, the most ambitious yet constructed and the most probable of success, contrast but meanly with the 'Nautilus.' The immense size of the latter, her speed of fifty miles an hour, the depths to which she descended, will be for many years, if not always, the imaginings of a story-writer, with no practical counter-

part. But that we shall at no very distant day be able to explore the shallower parts of the ocean, and recover some of the enormous wealth that lies hidden in wrecked vessels, there is little doubt. Already powerful electric lamps are used to illuminate the oyster-beds for the pearl-divers, being lowered to any depth required; and it is easy to predict that before long some submarine boat, propelled and powerfully lighted by electricity, will be searching for the wrecks of galleons and treasure-ships. The things most needed are faith in the success of the plan, daring, money for equipment and experiment, and, what is so often needed for a new application of electricity, a more perfect storage-battery.

ANOTHER NEW STORAGE-BATTERY. — Patents have just been granted to Louis Duncan of Baltimore for an improvement in secondary batteries. A great objection to the present battery lies in the fact that the inactive support-plate is heavier than the active material, — only one-third to one-fourth the total weight of plate is active in the ordinary cell, — while the limited surface prevents a heavy discharge-rate. With ordinary lead supports, an increase in surface causes an increase in the local action and depreciation of the cell, while any decrease in the thickness of the support also decreases the life of the cell. In this patent it is the intention to get a large surface, and a large proportion of active material to total weight, without decreasing the life of the cell. Broadly the idea is to coat the support-plate — a thin sheet of copper, washed with lead, in one of the claims — with a very dense layer of an oxide of lead, deposited on it from a solution of litharge in caustic potash, by means of a weak electric current. The deposit is so dense that it completely shields the sheet underneath from contact with the liquid: so, when the plate is put in sulphuric acid, there can be no local action between this coating and the lead beneath. By increasing the strength of current in the solution of litharge, the character of the deposit completely changes, becoming porous, and having a considerable electrical capacity. The positive plate, then, has four layers, — first, an outer active layer of peroxide of lead; second, a layer of dense peroxide that has no capacity; third, a thin coat of lead; and, lastly, the copper plate. Between the first and second layers there is no local action, because they are of the same chemical constitution; between the second and third there is no local action, since there is no liquid between them, while of course there is no action of the lead on the copper. We have no data as to any actual results. If the protective action of the dense peroxide claimed in the patent is really perfect, then a cell can be made with an immense surface for a given weight, and an excellent capacity. Such a cell should be of the greatest value, especially in traction-work; but no opinion as to the practical value of the cell is worth any thing unless supported by experiments carried on for a considerable time.

UNDERGROUND CONDUITS. — A meeting of the committee on underground conduits and conductors, of the National Electric Light Association, was held at the association headquarters, 16 East 23d Street, New York, on Tuesday, Dec. 11. The meeting was called to order at 2 o'clock P.M. by Mr. E. T. Lynch, jun., chairman. A preliminary discussion as to the present state of the art was entered into by the members present, and there seemed to be a very general impression that one of the most important things at present was to ascertain more fully and accurately than had heretofore been done, just what has so far been accomplished in this country touching upon the undergrounding of arc-light conductors. Several plans for accomplishing this were discussed, and the committee adjourned until Monday, Dec. 17, when definite plans for carrying out the work of the committee will be consummated. The members of this committee are E. T. Lynch, jun., chairman; F. B. Crocker; Gen. C. H. Barney; and Walter C. Kerr.

NOTES AND NEWS.

OBSERVATIONS have been made in India, South Africa, and Australia, which led to the conclusion that certain carboniferous rocks were formed by the action of ice. Conglomerates were found which contain large boulders of various materials, some of which have characteristic scratches and striae. Recently A. Derby found similar rocks in southern Brazil. The general appearance

of these rocks is much like those of India and South Africa, and it seems probable that their origin is due to the same causes which formed the latter. So far, no striae have been observed; but, as the region has not yet been investigated thoroughly, their existence is quite possible. The wide distribution of strata of this character is an undoubted proof that their origin is due to a general, probably a cosmic, cause; and among these, glacial action seems to be the most probable.

— It will be remembered that a number of elements had atomic weights which seemed not to be in correspondence with the demands of Mendelejeff's periodical system. Recent experiences have shown that these discrepancies were due to inaccurate determinations of atomic weights. K. Seubert has proved that the last of these discrepancies is due to the same cause. The theory demanded that the atomic weight of osmium be smaller than that of iridium, while former experiments gave the opposite result. Seubert has shown that the determinations which had been made by Berzelius and Frémy were inaccurate. He finds the atomic weight of osmium to be approximately 191, while that of iridium is 192.5.

— Hypnotism thrives in Washington. Two gentlemen interested in psychological studies, Mr. W. A. Croffut, executive officer of the Geological Survey, and Gov. N. J. Colman, commissioner of agriculture, give occasional *soirées hypnotiques*, at which they hypnotize numbers of "sensitives." During some recent experiments by Mr. Croffut, two young ladies, temporary victims of the hypnotic hallucination, were taken into an imaginary picture-gallery and there left, while the operator turned his attention to a young man who was engaged in the dangerous pastime of catching crocodiles. On returning to the ladies, Mr. Croffut found that he could not make them cognizant of his presence. They did not appear to see him, or hear his voice, and when he stood directly in front of them they took no notice of him whatever. It was a new and somewhat alarming experience, and a quarter of an hour passed before the hypnotizer re-established his domination, and brought them back from the land of dreams.

— Prof. J. P. Lesley has sent out a few final proofs of the first signatures of his report on the fossils of Pennsylvania, in the form of a dictionary, for the convenience of students and collectors of fossils in that State. It will be useful to them, and perhaps to others; but Professor Lesley claims no scientific merit for it, excepting that it contains a small number of new species discovered in the State collections, and named and figured by Mr. G. B. Simpson, in consultation with Prof. James Hall of Albany. The book itself is a compilation, which Professor Lesley made from various sources, mostly classical, and much of it old, and of difficult attainment by students of the present day. In the preface, when printed, all these sources will be fully recited. The book is going through the State Printing-Office at Harrisburg, will be bound in two volumes, and each volume distributed, when bound, separately.

— Mr. George F. Kunz, Hoboken, N.J., will purchase or take in exchange meteorites for fine crystallized or rare minerals. Intact falls, all the pieces of a fall, and newly found and undescribed ones, are especially desired; also aboriginal objects made of jade, jadeite, chlormelanite, pectolite or other allied minerals, or new occurrences of same; facts in regard to and specimens of American pearls, and American amber from all localities, especially if containing enclosures of wood, vegetable, or other living matter; gold and silver ornaments from the United States, and data concerning them. He is also desirous of securing the gem writings of certain ancient authors.

— It has long been known that rails of tracks in actual use oxidate much slower than those of dead tracks, but so far no satisfactory explanation has been found. W. Spring, in the Bulletin of the Royal Belgian Academy, shows that this is due to the formation of a coating of magnetic oxide of iron under the influence of humidity and pressure. In order to prove the correctness of this view, Mr. Spring has brought moistened rust and a clean plate of iron under a pressure of from a thousand to twelve hundred atmospheres, which corresponds to that of the wheels of a locomotive of a thousand hundredweights. He found that the rust-powder had penetrated the iron, and formed a coating of magnetic oxide.

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THE RECENT NEWS from the Equatorial Province shows that the Mahdi's successor, Abdullah, has as strong a hold upon the Mohammedan peoples of Egyptian Sudan as had his predecessor. While for some time the impression prevailed that the fanaticism of these tribes had abated, the attacks upon the English at Suakin proved at least that the Mahdi still swayed over the region from Khartum to Berber. It will be remembered that since the unexplained retreat of the Mahdi from the Equatorial Province Emin Pacha had been comparatively undisturbed, but about the end of last year rumors of a renewed attack reached the coast. It was stated that in March the Mahdi contemplated sending four thousand men on four of Gordon's old steamboats up the Nile, in order to attack Emin. If Osman Digma's message to the English be true, and not a trap, this expedition has been successful, and Emin has at last succumbed to the powerful religious movement which centres in Khartum, and with him Stanley, who had joined hands with him since November last year; and both would share the fate of the unfortunate Lupton and Slatin. It is said that a derwish named Omar Saleh returned some months ago from a success-

ful raid into the upper valley of the White Nile. He seems to have encountered Emin in October at Lado, and captured him and Stanley. Undoubtedly Emin would not have been able to withstand the attack of an expedition like the one referred to, and from his former behavior it does not appear probable that he would have retreated south-eastward. While the news is quite probable and credible, we may still maintain a faint hope that it has been merely invented to prevent the English from energetic action at Suakin. It has been stated before that the only real means of helping Emin would have been an attack upon the Mahdi from the north; but this, of course, was out of the question, since the English had given up the Sudan. Stanley's expedition was a failure, as, on account of his long delay and the destruction of his rear guard, he was unable to supply Emin with a sufficient amount of ammunition and trustworthy men. Neither would the planned German expedition have been of great account in a war with the Mahdi, as it would hardly have succeeded in opening a route to Emin, which latter would have been the only means of maintaining the rule over the Equatorial Province.

THE SELECT COMMITTEE of the Senate of the Dominion of Canada, appointed to inquire into the resources of the great Mackenzie basin, has collected a vast amount of information, which has recently been published, and of which we give abstracts in another place. Although much of the information contained in this report is too vague to be of value, the greater part is founded on sound reports of well-informed men, and our knowledge of the natural productiveness of this vast area is greatly increased. In weighing the economic value of the area under discussion, it must be considered that the northern limit of vegetable products and of pastureland does not coincide with the northern limit of profitable agriculture and stock-raising. In the report of the committee, the analogy of those parts of Russia near the northern limit of possible agriculture is frequently emphasized; but it must be borne in mind that the economic conditions of America and Russia are fundamentally different. Up to this time, agriculture in the new West is founded on extensive culture, no attempt being made to make the soil yield the largest possible continuous returns by intensive culture. At the same time a great portion of the immigrants do not settle there to make a living, but with the prospect of becoming wealthy. In Canada as well as in the United States a great number of settlers in the prairie territory are at the same time land-speculators. For these reasons the limit of agriculture will not approach as closely the limit of possible agriculture as it does in Russia, where a native population, loving the native soil, makes a hardy living. It is only when the economic conditions of the Western States shall have undergone a complete change that these northern districts, which are able to support a population, will become settled.

FERIA.¹

As director of the Hoagland Laboratory, I take advantage of this opportunity to congratulate Dr. Hoagland, the city of Brooklyn, and my present audience, upon the completion of this building, devoted exclusively to scientific research, and instruction in certain departments of biology; viz., in physiology, pathology, histology, and bacteriology. Indeed, I may extend my congratulations much further; for such a laboratory as this is a centre from which the rays of scientific learning will radiate to all parts of this great country, and which cannot fail to exercise an important influence upon the progress of knowledge in these fields of research. I do not know when Dr. Hoagland first conceived the idea of building and equipping a laboratory devoted to these fundamental branches of medical science, but it is now nearly two years since he made his first visit to Baltimore for the purpose of inspecting the laborato-

¹ Portion of a lecture delivered by Dr. George M. Sternberg at the Hoagland Laboratory, Brooklyn, Nov. 17, 1888.

ries connected with Johns Hopkins University. These had been recently built under the direction of professors familiar with the best laboratories of Europe, and Dr. Hoagland could not have found in Great Britain or on the continent any better models from which to make his plans. We are indebted to him not only for the money required to build and equip such a laboratory as this, but for his constant personal supervision and attention to details, from the first draughts of the plan until the moment of completion. I have been consulted from time to time; and the first visit to Baltimore was followed by several others, in which Dr. Hoagland carefully noted all of those minor details which go to make a laboratory complete and comfortable. The result is, as you see, a building thoroughly suited to the purpose for which it was designed, and which also, from an architectural point of view, is an ornament to the "City of Churches."

I have also been consulted with reference to apparatus; and we have here to-day, or on the way from Europe, every thing that occurred to me as essential for the equipment of the laboratory. The library has also been most generously provided for, and it is the intention to have upon its shelves not only standard books of reference, but, so far as possible, complete files of the English, French, and German periodicals relating to those branches of research to which the laboratory is devoted.

No one appreciates the advantages of such a laboratory as this more than I do, and I would be happy if circumstances made it possible for me to go into camp here during the balance of my working life. A pioneer in this country in the pursuit of bacteriological studies, I have seen to open up before me a most inviting field of research, presenting a multitude of important questions awaiting solution by the experimental method, and I have learned by experience how little can be accomplished in the absence of suitable laboratory facilities.

I have felt from the first that this country ought to take some part in the investigations relating to the etiology of infectious diseases, which have resulted, within the brief period of twenty years, in discoveries which will make this the most famous epoch in the history of scientific medicine. There can be no question that we have plenty of men who have the necessary intelligence and zeal to make them leaders in this or any other department of scientific investigation, but we have sadly lacked just those facilities which are furnished by this laboratory; for intelligence and zeal cannot take the place of training and a knowledge of the methods of research which have been perfected by the patient labors of others. The young man who starts out to make discoveries without such training is like the old farmer, who, after churning for years with an old-fashioned up-and-down, dash-churn suddenly conceives the idea that a churn with a crank would be an improvement, and applies for a patent, only to find that the same idea had occurred to thousands before him, and that patents have been granted on crank-churns of every conceivable form.

Our library takes the place of the patent-examiner. And when the trained investigator desires to follow any particular line of research, his first step is to find out what others have done before him; his second, to consider whether known methods and instruments will answer his purpose, and, if not, to devise and test such methods of research as occur to him.

With this brief introduction, permit me to proceed with the special subject upon which I am to address you.

Leeuwenhoek, the father of microscopy, first discovered the minute organisms known as bacteria in putrid water and in tartar from the teeth; but it was not until the present century was well advanced that the true character of these micro-organisms, and the important part which they play in the economy of nature, were recognized. We know now, that although certain species are pathogenic for man and the lower animals, and give rise to fatal infectious maladies, the bacteria as a class are essential for the continued existence of the higher plants and animals upon the surface of the globe and in the waters of the ocean. It is their function to return to the earth and the air those elements and simple compounds which go to make up the complex organic structures which enter into the composition of the tissues of living plants and animals. So soon as the physiological processes upon which vitality depends have ceased, either from external or internal causes inter-

fering with the integrity of organs essential to life, these universal destroyers commence their work, and those putrefactive changes are inaugurated which result in the disintegration of animal and vegetable tissues. It is evident, that, if no such disintegrating agency existed, the surface of the earth and the waters of the ocean would soon be encumbered with dead plants and animals, and the course of animate nature would be arrested, both by occupation of available space and by exhaustion of nutritive material.

These processes of decay, which in animal bodies exposed to the air occur so promptly, under favorable conditions as to temperature and moisture, are going on continuously in the upper layers of the soil, where the roots of annual plants, and the organic material turned under by the plough of the farmer, must be reconverted into elementary substances which can be appropriated by growing plants. In the ocean the same thing occurs, — the myriads of fish and other living creatures which perish every day are quickly invaded by these omnipresent micro-organisms, and undergo disintegration.

The question may be asked, 'What, then, becomes of these putrefactive organisms, and what prevents them from taking full possession of the waters of the deep?' Like other living organisms, they have their life-cycle, and perish at the end of a given period, and, like other living organisms, their multiplication is limited by the amount of available material. Moreover, they serve as food for a multitude of micro-organisms a little higher in the scale of existence, and especially for the *Infusoria*.

Under this name — *Infusoria* — the older naturalists included all of the minute unicellular organisms observed by them in putrefying infusions. At present this name is applied only to unicellular animal organisms, and among the unicellular vegetable organisms the bacteria have been differentiated from the *Palmellaceæ*, the *Saccharomycetes*, and the reproductive elements of the higher *Algæ*, all of which were formerly confounded under the general name of *Infusoria*.

Ehrenberg (1838) was the first to separate the bacteria as a distinct class of organisms, under the name *Vibrioniens*; but he did not include the spherical bacteria — micrococci — in this class, and did not recognize the vegetable nature of these micro-organisms. In his family of *Vibrioniens* he included four genera, which he defined as follows: 1. *Bacterium* (filaments linear and inflexible); 2. *Vibrio* (filaments linear, snake-like, flexible); 3. *Spirillum* (filaments spiral, inflexible); 4. *Spirochate* (filaments spiral, flexible).

Dujardin (1841), in his 'Histoire Naturelle des Zoophytes,' still preserved the family of *Vibrioniens* of Ehrenberg among the *Infusoria*, and it was not until 1859 that the eminent French physician Davaine clearly recognized the bacteria as vegetable organisms nearly allied to the *Algæ*, — a view which was subsequently adopted by the distinguished German botanist Cohn, and which is pretty generally accepted at the present day. Some botanists, however, insist upon the affinities of the bacteria with the microscopic fungi, and it is this view which has induced Nägeli to describe them under the name of *Schizomycetes*, or fission fungi. The chief ground for this classification is found in the fact that the bacteria, like the *Mucorini*, are destitute of chlorophyll.

The vegetable nature of yeast-cells had previously (1836) been recognized by Cagniard-Latour and by Schwann; and the vitalistic theory, as regards the alcoholic fermentation, was clearly defined and established experimentally by the last-mentioned author in 1837. This theory was subsequently extended by Pasteur to processes of fermentation and putrefaction in general; and, in the face of much conservative opposition, the distinguished French *savant* finally demonstrated that in the absence of these living ferments organic liquids may be kept indefinitely without undergoing change; and that contact with the atmosphere does not induce these changes, as had been generally supposed, but that when they follow such contact it is due to the presence in suspension of living micro-organisms.

Hoffmann (1843) had previously shown that calcined air admitted to a boiled organic liquid does not cause putrefaction, and in 1854 Schroeder and Von Dusch showed that the suspended particles in the atmosphere may be removed by passing air through a cotton-wool filter.

For a time the advocates of abiogenesis supposed that they had

demonstrated by experiment that micro-organisms may develop in an organic liquid sterilized by heat; but Pasteur showed that the boiling temperature does not destroy all germs, and that to insure sterilization of a neutral or alkaline medium a temperature of 110° to 112° C. is required. The same *savant* first recognized the fact that this failure to sterilize organic liquids by boiling at the ordinary barometric pressure was due to the presence of reproductive bodies, which he described under the name of 'brilliant corpuscles,' 'germs,' 'conidia,' etc. These spores had previously been seen by Perty in 1852 and by Charles Robin in 1853, but it was not until 1876 that their mode of formation and true function were definitely established by the German botanist Cohn. In the same year Koch published in Cohn's *Beiträge zur Biologie der Pflanzen* his admirable memoir, 'Die Aetiologie des Milzbrandkrankheits,' in which he showed that endogenous spores are produced, under certain circumstances, by the anthrax bacillus, and that these are true reproductive bodies. In 1881 the same author published in the *Mittheilungen aus dem Kaiserlichen Gesundheitsamte* his disinfection experiments, in which these spores served as the test of the disinfecting power of heat and of various chemical agents. These experiments showed that dry heat was very much inferior to moist heat for the destruction of these bodies, and that when perfectly dry they resisted for several hours a temperature of 20° C. above the boiling-point. To insure their destruction, a temperature of 140° C., maintained for at least an hour, was found to be necessary. When, however, the spores were immersed in boiling water, or in steam given off from the same at the ordinary pressure of the atmosphere, it was found that a few minutes sufficed to destroy the vitality of these spores.

The demonstration that the atmosphere constantly contains in suspension the living ferments which cause putrefactive and fermentative changes in organic liquids led to the belief, still entertained by many who are not familiar with our bacteriological methods, that the slightest exposure must insure the entrance into such a liquid of these ubiquitous germs.

Pasteur first showed that the liability to contamination by a brief exposure to the air is by no means so great as had been generally supposed, and that, as a matter of fact, a putrescible liquid rarely becomes infected by such exposure as occurs in the ordinary laboratory operation of removing the cotton air-filter for the purpose of inoculating a culture. This is now a matter of every-day laboratory experience; and the fact, also demonstrated by Pasteur, that upon the surface of objects, and especially in accumulations of dust, these living ferments abound in great numbers, is now generally recognized.

Up to the time of Cohn, botanists had paid but little attention to the minute vegetable organisms under consideration; and but for the discovery that some of them invade the human body as parasites, and thus give rise to fatal forms of infectious disease, it is probable that we would still be ignorant of their real characters. The earlier botanists had no conception of the great number of species existing, — species which we now know are in many instances as well defined, and apparently as permanent in their characters, as is the case with plants higher in the scale of living things. The older botanists generally adopted the view that these low organisms are polymorphous, and that there are but a small number of distinct species. Indeed, until the illustrious German bacteriologist and physician gave us a reliable method for isolating the various forms which are commonly associated in putrefying infusions, it was impossible to determine what relation the little spheres, rods, and spiral filaments revealed by the microscope might bear to each other. Since Koch's methods have been employed by industrious investigators in all parts of the world, we have commenced to learn something of the bacterial flora; and it is apparent that the number of distinct species is enormous, — comparable, for example, with the number of well-defined species of diatoms, desmids, or other classes of *Algæ* higher in the scale. This flora is no doubt different in different parts of the world, although some species are widely distributed, and we may expect to discover many new forms when bacteriologists extend their researches to distant portions of the globe, and especially in the tropics. Already extended researches have been made, especially in Germany, with reference to the bacterial flora of the soil, of streams and wells, and of the atmosphere;

but this line of research may be said to be still in its infancy, and what has been done only serves to indicate the extent of the field and the amount of work which remains to be done before our knowledge will be complete. The same may be said of the bacterial flora of the intestine of man and of the lower animals. Here we have not only to determine the constant species, as distinguished from the accidental, and in some cases no doubt pathogenic forms, but we have also to determine the physiological rôle of each constant form; for we can scarcely doubt that these commensals of man, which help to disintegrate the organic pabulum introduced into the alimentary canal, and give rise to the formation of a variety of chemical products, some of which are known to be toxic, play an important part in the economy of the individual.

With the methods now at our command, these questions, and those relating to the physiological characters of pathogenic species, are open to investigation. But let me warn the young bacteriologists of to-day not to plume themselves too much upon the scientific achievements which await them in the application of these methods, and to remember that the serious errors which in the past have been made by many of the pioneers in this field of investigation were in many instances due, not to an inferior degree of intelligence or a less earnest desire to get at the exact truth, but to the difficulties which they encountered in a new field of investigation, in which satisfactory methods of research were not yet developed.

The great impetus which bacteriological studies have received since the introduction of Koch's plate-method and the use of solid culture-media, is shown by the recent literature of the subject. Prior to this date (1881) the number of active workers in the field was small, and much of the work done had little scientific value from our present point of view. Morphological differences were the chief reliance for differentiating species, but we now know that such distinctions are entirely unreliable. Many species which have important and permanent physiological characters, which serve to distinguish them in a definite manner, are practically identical in their morphology. Thus, for example, no bacteriologist would attempt to decide, by a microscopical examination alone, whether a coccus obtained from the pus of an acute abscess was the staphylococcus aureus, citreus, or albus; but the growth upon a solid culture-medium would decide the matter by the characteristic color of the mass developed about the point of inoculation. A great part of the work to be done in bacteriological laboratories consists in this differentiation of species, and in defining in an exact manner the biological characters of each, including mode of growth in various media, resistance to chemical agents and to heat and cold, pathogenic power, etc.

As indicating the progress in this department of science and the character of the work already done, I propose to make a brief analysis of the literature of the subject. In a bibliography at hand, which is quite full without being complete, I find reference to 41 papers published prior to the year 1860. Of these, 7 are in German, 31 in French, and 3 in English. During the decade from 1860 to 1870 the same bibliography gives the titles of 55 papers, of which 8 are in German, 43 in French, 3 in Italian, and 1 in English. The following decade, 1870 to 1880, shows a very greatly increased activity in this field of research; and among the titles given we have in Germany papers by Buchner, Billroth, Cohn, Eberth, Frisch, Hiller, Klebs, Koch, Letzerich, Nägeli, Orth, Pragmowski, Weigert, Wernich, and others. In France the most prominent names during this period are those of Arloing, Cornevin, and Thomas, Béchamp, Paul Bert, Bouley, Chauveau, Colin, Davaine, Donné, Felz, Miquel, Pasteur, Van Tieghem, and Toussaint. In England the most important contributions during the same period were by Bastian, Beck, Cunningham, Dallinger, Dougall, Klein, Lewis, Lister, and Sanderson. The total number of titles included in my bibliography is 329, of which 122 are German, 121 French, 57 English, and 9 Italian. From this time the interest in this field of investigation, as shown by the literature in which experimental investigations are recorded, has very rapidly increased. My bibliography gives the titles of 92 papers published during the year 1881, of which 27 are in German, 45 in French, 16 in English, and 4 in Italian.

Passing over the years 1882, 1883, and 1884, I take from the valuable 'Jahresbericht' of Baumgarten, first published in 1885,

the following figures, which, for convenience, I have arranged in tabular form:—

TITLES OF PAPERS RELATING TO BACTERIOLOGY.

Year.	German.	French.	Italian.	English.
1885.....	119	19	5	5
1886....	291	58	44	23
1887....	483	124	66	55

No doubt the great increase in the number of papers during the year 1887 is in part due to the fact that the bibliography is more complete, and many papers of minor importance are included. It must be remembered, also, that quite a number of the Italian bacteriologists, and some of the students from this country who have pursued their bacteriological studies in Germany, publish their papers in the German language.

It will be seen from what has been said, that while the French took the lead in researches in this department prior to 1870, and during the following decade (1870–80) contributed about the same number of memoirs recording experimental work as the Germans, the last-mentioned nation is now far ahead not only as regards the number of workers in the field, but, I may add, in the scientific value of the work done; while the number of workers in this field of investigation is even less among English-speaking people than among the Italians. I am not willing to admit that this difference is due to race characteristics alone, although the Germans are noted for the thorough way in which they devote themselves to the elucidation of scientific questions by the experimental method. The great activity in France during the period included between the years 1860 and 1880 was without doubt largely due to the influence of Pasteur, who, by his experimental work and his writings, did more than any other man to establish the fact that the minute organisms, which prior to his time had received so little consideration, are important factors in the economy of nature.

In the ante-Koch epoch there was no name in Germany to compare with that of the illustrious French *savant*; and if, from our present point of view, we can point to certain errors of inference, due to the imperfect development of bacteriological technique, these cannot be held to constitute a serious blemish upon the brilliant scientific record of Pasteur. Where are the pioneers who have never followed a false trail? The true distinction of the man of science is that he renounces his own errors as soon as he is convinced that he has made one.

Among the pioneers in bacteriological researches in France, there is one who, next to Pasteur, is entitled to special consideration. I refer to the distinguished physician and scientist, Davaine, whose first paper upon the anthrax bacillus was published in the *Comptes Rendus* of the French Academy in 1863. Certainly the work of Davaine, of Chauveau, and of Toussaint may be compared favorably with that of the German physicians, who contributed most largely to the literature of our subject before the time of Koch.

The discovery by Obermeier, in 1873, of the spirillum of relapsing fever was a notable event in the history of bacteriology, and at once attracted the attention of physicians in all parts of the world to this class of micro-organisms; and it is to physicians, rather than to the botanists, that we owe the rapid development of our knowledge of these minute plants.

A great impetus was given to bacteriological studies in Germany by the introduction by Weigert (1877) of the aniline dyes for staining these micro-organisms.

Koch, in referring to this new method in a paper published a few months after Weigert's first publication regarding it, says that "the aniline colors are retained by micro-organisms with such intensity and with such rapidity, that we may consider these colors re-agents for distinguishing the bacteria from crystalline deposits, or amorphous material of any kind, from fat drops or other corpuscles of small dimensions." From this time these dyes have been our main reliance for differentiating the bacteria from organic and inorganic granules which often resemble them closely in form, and for demonstrating their presence as parasites, in the blood and tissues of animals, in the infectious maladies.

Dr. Robert Koch, who is now generally recognized as the foremost bacteriologist of the world, published his first papers during the years 1876 and 1878, in Cohn's *Beiträge zur Biologie der Pflanzen*. In 1878 his 'Untersuchungen ueber die Aetiologie der Wundinfectionskrankheiten' appeared. These publications marked him at once as a master in experimental investigations, and as a most careful and reliable observer.

Schroeter, in 1872, had made use of slices of boiled potato for the cultivation of chromogenic bacteria, but the method of cultivation in solid media was first described by Koch in Vol. I. of the *Mittheilungen aus dem Kaiserlichen Gesundheitsamte*, published in 1881. This method, together with his plate-method of isolating bacteria, is the foundation-stone upon which the bacteriology of the present day has established itself; and since the road has been pointed out numerous workers in all parts of the world have hastened to explore the previously unknown mines of truth in this important and attractive department of biology.

There are to-day bacteriological laboratories not only in many of the large cities of Europe, from Russia to Spain, but also in a number of the principal cities on this side of the Atlantic. During my recent visit to the City of Mexico, I found a complete equipment of Koch's culture apparatus, and of the apochromatic objectives of Zeiss, in the laboratory of Dr. Carmona y Valle, and in Havana a similar outfit in the laboratory of the 'Cronica Medica,' under the direction of Dr. Santos Fernandes.

The rapid progress of bacteriology in Germany has been due not alone to the epoch-making achievements of Koch, but also, to a very considerable extent, to the enlightened policy of the government. Koch was called to Berlin as soon as his merit was recognized, and his work was carried on in the laboratories of the Imperial Board of Health, where he had the assistance of those medical officers of the German army whose names stand only second to his in the record of valuable work done in this department of science. I refer, of course, to Loeffler, to Gaffky, and to Wolffhügel; and to these associates in his earlier researches may be added the names of Plagge and of Weisser, who have been with him in his new laboratory.

If during the past ten years we had also had a well-equipped laboratory, under proper direction, at the seat of government, does any one doubt that men could have been found in the medical corps of the army and of the navy who would have done work in this department of scientific research which would have been creditable to us as a nation?

Certainly it is not creditable that we, as a nation, have contributed so little to the progress of knowledge in this direction. Let us hope, however, that we are entering upon a new era. Here in Brooklyn private munificence has provided the means of research which the national government should have provided long since; and here, at least, the fault will rest with the profession, if active workers are not found to avail themselves of the facilities provided for making original researches in bacteriology, in physiology, and in experimental pathology.

Another important landmark in the progress of bacteriology and of scientific medicine is the discovery of the tubercle bacillus, and the demonstration that it is the specific etiological factor in the causation of tuberculosis. As you well know, we are also indebted to Koch for this discovery, which was first announced in the *Berliner klinische Wochenschrift* in 1882.

[Having referred briefly to some of the principal facts relating to the history of the subject, Dr. Sternberg occupied the remainder of the time during the lecture in giving an account of the morphology of micro-organisms.]

PROF. WILLIAM H. PICKERING has succeeded in detecting a number of new nebulae by means of photography. The region surrounding the nebula of Orion was selected for these experiments, and from the results the author concludes, that, by photographing the entire sky, four or five thousand such objects may be discovered. Only in case the large nebula of Orion should prove to embrace all the new nebulae in its limits, this proportion would not hold good. The experiments show, however, that the method is well adapted to verifying and completing our catalogues of stars.

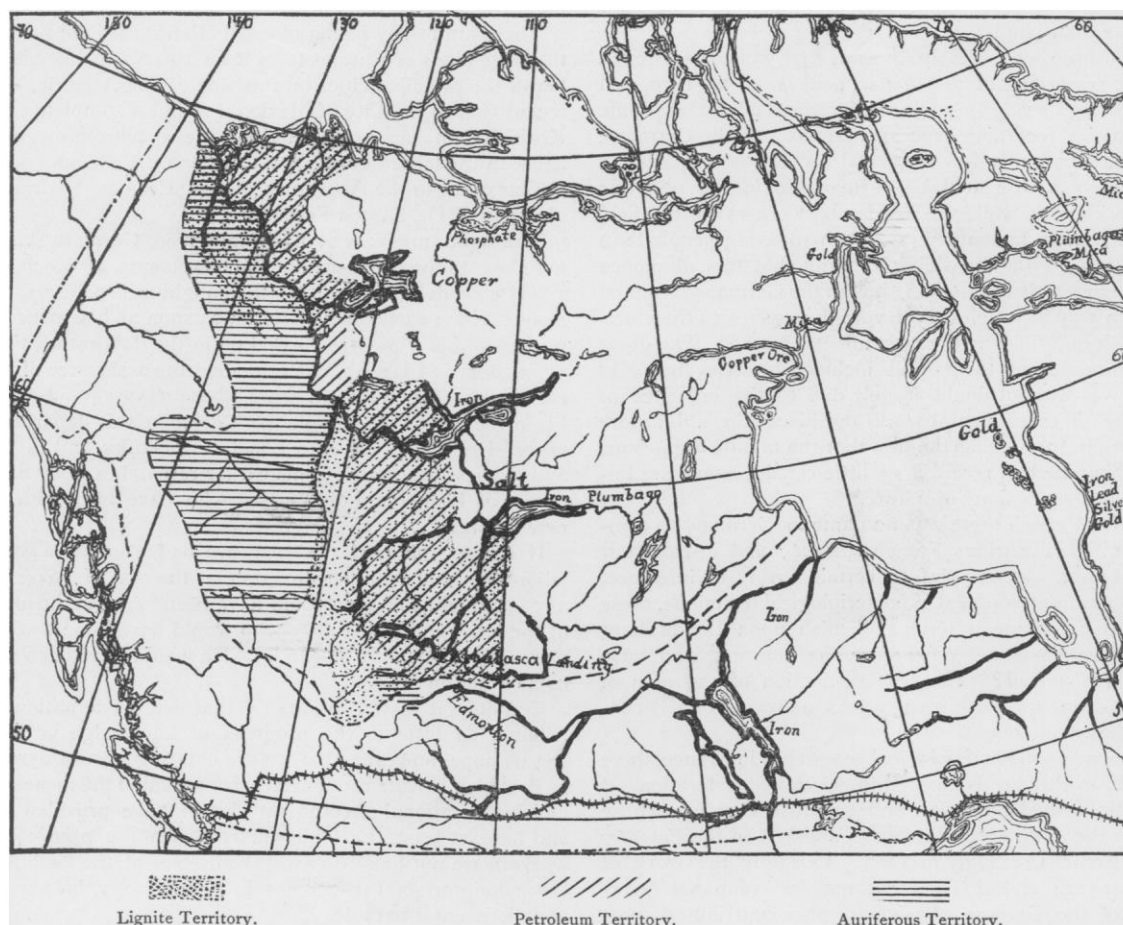
THE GREAT MACKENZIE BASIN.

THE select committee of the Senate of the Dominion of Canada, appointed to inquire into the resources of the Mackenzie basin, has made its third report, which embodies a vast amount of information. The report is accompanied by a series of valuable maps, on which the extent of navigable waters and the distribution of mineral and other products of the country have been laid down. From these maps we have compiled the accompanying sketch-maps, which give a comprehensive review of the results of the committee's investigations.

One of the remarkable features of the country under consideration is the great extent of navigable rivers. The Hudson Bay Company has always availed itself of this fact by using the water-ways, even when circuitous and difficult, rather than resort to land-car-

The great value of the fur trade in this vast region is so well known that it is not necessary to dwell on the remarks of the committee. Dr. R. Bell's map of the distribution of fur-bearing animals, which accompanies the report, will be found very instructive.

Extensive tracts of land have been traversed by miners, and the southern and eastern districts have in part been explored by members of the Geological Survey. From these and other sources an account of the economic sources of the Mackenzie region has been compiled, from which it appears that there are hardly any layers that would pay to be worked, the auriferous region adjoining the Rocky Mountains perhaps excepted. The extensive petroleum fields which are suspected to exist all along the Mackenzie may become of importance with the progressive settlement of Saskatchewan and Alberta. The committee is inclined to consider this oil-



The heavy lines show the navigable river-stretches and shore lines of lakes.

riage; and their inland posts, to as far north as the Arctic Circle, are now supplied from their central depot at Fort Garry, with only 114 miles of land-carriage, the greater part of which is from Edmonton to Athabasca Landing. From the latter place steamers and flat boats run to Fort Smith, on the Great Slave River, where twenty miles of wagon-road connect the shallow with deep water navigation; and a steamer distributes goods to the various posts down to the mouth of the Mackenzie, just above its estuary, where the river is said to be six miles wide, and up Peel River, which joins the Mackenzie near that point, to Fort Macpherson, on that gold-bearing stream. The great lakes which receive the drainage of this vast region, and give an equal flow to the Mackenzie, all have deep-water navigation, and, like most lakes of the Laurentian formation, are studded with islands. The western affluents of the Mackenzie are believed to form valuable links as a means of access to the mining districts of Peace and Liard Rivers. We have indicated by heavy lines those stretches of rivers which are considered navigable.

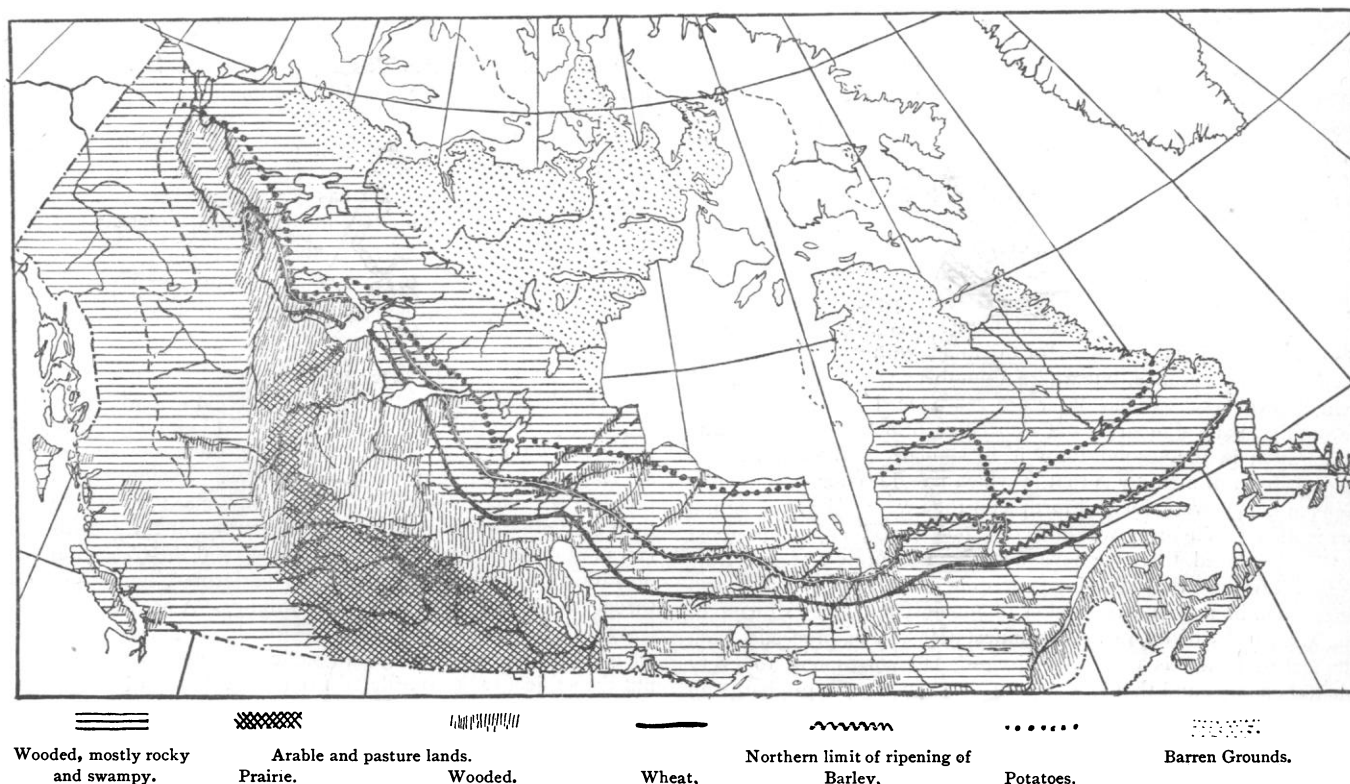
field of the greatest value, and recommends its thorough exploration.

The principal question, however, is the extent to which agriculture can be carried on in the region under consideration. From a geographical point of view, the determination of the limits of the Barren Grounds is of great interest. For agricultural or pastoral purposes the greater portion of the wooded parts of the country is also waste land, the timber being of no commercial value, and the land being incapable of yielding any crops or of supporting sheep or cattle. Although many of the informants of the committee were inclined to describe the northern portions of the country too favorably, good judgment has been shown in not using such information in the construction of the map. It will be observed that the prairie region sends forth a narrow arm north-westward towards Peace River. The soil of this region is described as very fertile, but early frosts in August deprive it of much of its value. Notwithstanding this fact, it must be considered well adapted for stock-raising, and capable of supporting a considerable population. As the settle-

ment of the fertile prairie region on the Saskatchewan advances, these regions and their produce will become more valuable. It is worth remarking in this place, that the region near the southern limit of forests is far more valuable than the arid prairies near the forty-ninth parallel, adjoining Dakota and Montana, which are crossed by the Pacific Railroad. The political considerations which have determined the southern location of this road will undoubtedly prove to have retarded the growth of the Canadian North-West Territories. The information regarding the forest-covered area on the Mackenzie River, north of Great Slave Lake, is very scanty, and it appears doubtful whether the committee's views regarding its value as a pastoral area are justified.

On the whole, it appears that the south-western portions of the Mackenzie basin are far more productive than they were formerly believed to be, and that they are capable of supporting a consider-

pancy as that to which we refer, impossible any longer, for it brings within the reach of every teacher and student in the land a scientific and practical and modern treatment of the subject of memory and its cultivation. Professor Harris, the editor of the series, prefaces Mr. Kay's book with an interesting introduction, in which he sums up the result of the author's discussion. He says, for example, "Memory is not one faculty, so to speak, but a condition of activity of all faculties. There is one memory of places, another memory of the names of places; one memory of persons, another memory of the names of persons; still another memory of dates; another of principles and causes; and so on. The cultivation of one species of memory may assist or it may hinder another kind of memory, according as the mental activity by which the attention is fixed on one subject aids or hinders the mental activity of the other kind of memory" (p. vi.). We are disposed to think that Profes-



able population. The country is far from being rich, and, while more promising areas are open to settlement, progress will be slow; but there can be no doubt that in course of time its prairies, woods, and mineral resources will give support to thrifty communities.

BOOK-REVIEWS.

Memory: What it is, and how to improve it. By DAVID KAY. New York, Appleton. 16°.

THIS volume, the eighth in the International Education Series, is in some respects the most important and interesting yet issued. We by no means underrate the value of Rosenkranz's 'Philosophy of Education,' nor that of Mr. Brown's translation of Preyer's 'Die Seele des Kindes;' for those works are broadening and stimulating, and should be read by all those teachers who are seeking to perfect themselves in the philosophy of their profession and to extend their knowledge of the phenomena of the child-mind. But Mr. Kay, in his treatment of memory, has had an opportunity to discuss, in the light of modern physiological and psychological research, a subject about which there has been a vast amount of almost wilful misunderstanding and ignorance. The commanding place which verbal memory occupies in the schools of to-day is a relic of the system of teaching current for the last five hundred years, and is the result of permitting educational practice to lag far behind psychological investigation. Mr. Kay's book makes such a discre-

sor Harris does Mr. Kay an injustice in stating (p. xiii.) that Mr. Kay has not discussed the physiological side of memory with reference to the most recent special researches in physiological psychology. To be sure, we find no reference to Wundt, Volkman, James Ward, Ebbinghaus, Fechner, or Meynert; but Ribot is quoted and referred to with great frequency, and we have also noticed quotations from Michael Foster, Dr. Carpenter, Dr. Maudsley, George Henry Lewes, Bernstein, E. Hering, Müller, Dr. L. S. Beale, Helmholtz, Du Bois-Reymond, and others, who are certainly in touch with the most modern theories in the branch of knowledge referred to. In fact, so far are we from agreeing with Professor Harris, that we are disposed to think that the first four chapters of Kay's book, which discuss 'Memory,' 'Matter and Mind,' 'The Body,' and 'The Senses,' form the most accurate and concise introduction to the study of physiological psychology that we have yet seen.

Every reader will be struck with the number of the author's citations. They are more than one thousand in number, and are taken from over two hundred authors. They in themselves would form an interesting *olla podrida* of what has been said and written about the subject with which the book deals. The author strikes at the current misconception of memory in the first pages of his book, and remarks (p. 13) that "a leading error that arises in regarding the memory as a single faculty is the belief, that, in whatever direction we exercise it, we improve it as a whole. This, however, is very far from being the case. If we exercise it only in one direction, we

improve it only in that direction. The exercise of the ear in hearing does not improve the power of vision, nor, while we strengthen the memory for sounds, do we improve that for sights. Even in a single sense or faculty, we find different forms and degrees of memory, as in sight for persons, places, forms, colors, and the like. Hence we may cultivate the memory for persons without at all improving that for places, and a good memory for colors may afford little help toward the remembrance of forms. . . . Another error that may be traced to the same cause is that of regarding the memory only or chiefly as it is manifested in its lower forms, and hence depreciating or undervaluing its importance. . . . The memory for names and words is the lowest form of memory, and fools and even idiots are sometimes found to manifest it in a very remarkable degree. Hence to judge of the value and importance of memory simply from the lower aspects of it is manifestly unfair. The memory for words is only one form of memory, besides which there are memories for ideas, for processes of reasoning, for creations of the imagination; and to say that memory interferes with efficiency of any of the other faculties is to regard as one thing what is in reality many things, and to confound the lower forms of it with the higher." The author distinguishes three kinds of forms of memory. The first, or lowest, is the local or verbal memory, which is the power of remembering facts in the order in which they occur, or words in the order in which they were addressed to the individual. This form of memory is very ready, and more or less imposing; it is nevertheless a manifestation merely of a mind which is very receptive to sense-impressions, and which consequently recalls them with great accuracy.

The second and higher form of memory is that in which not merely an individual past state of the mind, with its attending circumstances, is recalled, but where a number of past states having some resemblance to each other are reproduced at the same time. In the first kind of memory the associative principle at work was contiguity; in the second form it is similarity. The third and highest form of memory is that in which past ideas or past sensations are, as it were, imaged forth as if they were objects of actual perception. Wherever we find this power of imagination most highly developed, there we have memory in its most perfect form.

It will be seen that Mr. Kay is writing strictly on physiological lines when he makes this division of memory and his estimate of the importance of its various manifestations. He proceeds from the fact that there is a nervous discharge to correspond to every mental change, and that in the case of memory the discharge in question takes place in the same tract as it did when the presentation, now recalled, was originally perceived. He does not, however, confine himself to the opinion generally held by physiologists, that the movements on which our recalled sensations depend are confined to the brain, which may therefore be regarded as the sole seat of the memory. Mr. Kay says that this is the case in many instances; for instance, where the previous sensation is but imperfectly recalled. He contends, however, that where the previous sensation is brought back with any degree of vividness, as in the highest form of memory, the motion is not confined to the brain, but is conducted "also to the connecting nerves, and often to the special organ of sense, as in the original sensation, with this difference: that in sensation the motion originates in the external organ, and travels inward to the centre; whereas in recollection it originates in the centre, and passes outward to the outer organ" (p. 33). He supports himself in this opinion with a quotation from Professor Bain, and with some interesting experimental cases which we have not space to record. As a result of this opinion, the author can conclude that the senses are not only necessary for receiving impressions, but are necessary also for imaging them in the memory; and the muscles are not only necessary for the performance of actions, but necessary also for the full remembrance of them. Hence not the brain alone, but the whole body, is the true seat of memory.

We have given this rather full digest of Mr. Kay's views, because it is necessary, in reading and estimating the book, to know on precisely what foundation it builds. We cannot follow him over the remaining chapters of his book in as much detail, but we most cordially recommend his pages to the attention of all students of memory, and all who are engaged in the practical work of teaching. What he says about attention and association is, of course,

well known to all save those who spend large sums of money in endeavoring to train the memory according to some secret and newly discovered "physiological" process. A careful study of Mr. Kay's book will dispel all illusions concerning such memory-training, and also make it plain that mnemonics as popularly understood is a self-evident absurdity; in that, instead of grasping a natural and real association, it calls up an artificial one, and makes it necessary for the mind to retain not merely the things associated, but the artificial bond of association which has been placed between them.

Mr. Kay's chapter on "How to Improve the Memory" is the shortest in the book, and reasonably so. If a clear impression of a sensation increases the likelihood of its being remembered, it is evident, that, in order to train the memory, we must begin by training the attention; if an idea can be the more readily recalled according as it is more easily associated with other ideas, then it is evident, that, after training the attention, we must train the power of associating ideas—not in an artificial and superficial way, but in accordance with the real connection existing between the ideas themselves; and, lastly, if there are memories, and not a memory, practice and exercise of any particular kind of memory is necessary in order to make it efficient. These are the practical rules resulting from Mr. Kay's treatment, and they are rules fully justified by physiology and psychology. The author has given us the best and most compact, the most accurate and the most practical, treatment of memory that we know of.

Case of Emperor Frederick III. Full Official Reports by the German Physicians and by Sir Morell Mackenzie. New York, Edgar S. Werner. 12°. \$1.25.

THIS volume of 276 pages gives a complete account of one of the most celebrated cases of modern times, beginning with the month of January, 1887, when the Crown Prince of Germany felt the initial symptoms of his fatal illness, to June 15, 1888, the day on which as emperor he succumbed to its ravages. Twenty-two illustrations serve to make the reports of the physicians more intelligible than they otherwise would be. These represent the growth in the larynx at different stages of its progress, and the trachea after the operation of tracheotomy had been performed, with the canula through which air was admitted to the lungs. A perusal of this book leaves the disputed questions no nearer a solution than before, and we must be content to wait until sufficient time has elapsed to permit the subject to be considered from a purely scientific standpoint, without bias, either national or professional.

AMONG THE PUBLISHERS.

THE January number of *The Chautauquan* is replete with valuable and interesting matter. The following is the table of contents: 'Gossip about Greece,' by J. P. Mahaffy, M.A., of Dublin University; 'Nicias,' by Thomas D. Seymour, M.A., of Yale University; 'Greek Mythology,' by James Baldwin, Ph.D.; 'Sunday Readings,' selected by Bishop Vincent; 'Music among Animals,' by the Rev. J. G. Wood; 'The Effect of Explosives on Civilization,' by Charles E. Munroe, chemist of United States Torpedo Corps; 'Hospitals,' by Susan Hayes Ward; 'The Indians of the United States,' by J. B. Harrison; 'An Autocrat in Feathers,' by Olive Thorne Miller; 'Educate the Hand,' by Dr. T. L. Flood; 'The Chinese in the United States,' by Wong Chin Foo; 'Finland and the Finns,' by Bishop W. F. Mallalieu, LL.D.; 'Temperance Laws in the States and Territories,' by the Hon. H. W. Blair, United States Senator from New Hampshire; 'Working Girls' Societies,' by Grace H. Dodge; 'Alexander Hamilton,' by Coleman E. Bishop; 'Chapultepec,' by Eugene McQuillin; besides the usual editorial and C. L. S. C. departments. The poetry of the number is by Ada Iddings Gale and Hjalmer Hjorth Boyesen.

— The December number of *The Canada Educational Monthly* opens with an article on 'Some Antecedents of Montreal,' by Sir J. William Dawson, followed by the second part of the annual convocation address of President Sir Daniel Wilson of University College, Toronto. The first instalment of a brief history of Knox College, from the pen of Professor Gregg, next appears; then an article by Professor Fletcher, of Queen's, on 'University Matricula-

tion in Classics;' another on 'Botany in Country Schools;' and one on 'Professor Montgomery's Recent Explorations in Dakota of the Remains of Mound-Builders.'

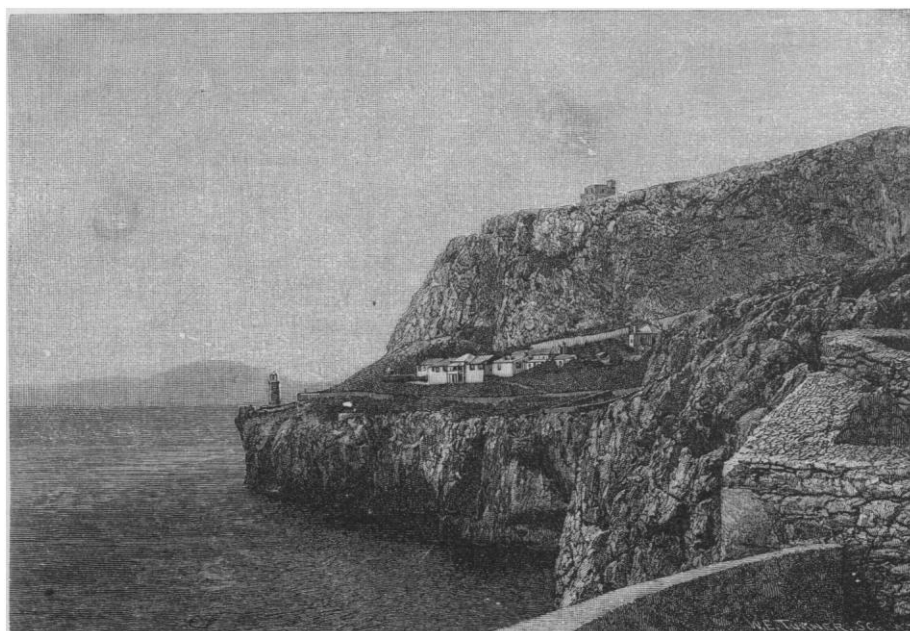
— Charles Scribner's Sons have just ready a new volume by the Rev. Dr. Henry M. Field, in which the famous traveller describes Gibraltar,' giving an historical survey of the fortress and town. The Diary and Letters of Gouverneur Morris,' edited by Anne Cary Morris, also just issued, is crowded with material of international interest.

— Scores of books have been written about Spain and about northern Africa, but it has been left for Dr. Henry M. Field to write a most interesting volume about that unique bit of English territory that lies between these regions, 'Gibraltar' (New York, Scribner). The place is one that travellers are wont to give the go-by, and this fact imparts an unusual degree of novelty and freshness to Dr. Field's picture. The book gives, in a lively, entertaining narrative, just what we would wish to know about the fortress of Gibraltar, its appearance, history, construction, military and social life, etc. One climbs the rock with the author as a guide and com-

glances at the traits of its great marshals; the social conditions, both as they promise development and as they are still unripe for the complete freedom of expression of public opinion in the press or otherwise; the Philistine and his carping pettiness; society and the womankind; the family life and recreation and amusement, — all are glanced at and commented on, and anecdotes and instances supplied.

— D. Lothrop Co. have under way a book of travel by Henry E. Rhoades, of the Engineer Corps of the Navy, who was associated with Lieut.-Commander De Long, Lieutenant Chipp, and Chief Engineer Melville in the 'Polaris' Search Expedition in the Arctic in 1873, and who has been twice almost around the world. It will deal in an interesting way with the habits and customs of the people of the West Indies, of Brazil and other countries of South America, of Africa, Madagascar, the Comoro Islands, Arabia, India, China, Japan, Greenland, etc., and will be appropriately illustrated.

— It is a great compliment that the *Youth's Companion* has been appointed to be read in schools in various localities, Toledo among them.



From 'Gibraltar.'

A VIEW OF GIBRALTAR.

Charles Scribner's Sons.

mentator, goes through the fortifications, strolls around the town, is present at a parade, gets a glimpse of the society of the place, reviews the great siege more than a hundred years ago, with all of its details of heroism on the part of the besieged English and their French and Spanish assailants, and finally sails away from the picturesque spot to Africa. The numerous illustrations aid the reader materially in getting a capital idea of the famous fortress and town, and their surroundings.

— Macmillan & Co. will issue immediately 'Japan and its Art,' by Marcus B. Huish, founded on papers in the *Art Journal*, but revised and extended. The book, say the publishers, is the result of a year's constant intercourse with the most competent Japanese experts, and of study of the principal European collections. It will contain upwards of one hundred illustrations.

— Messrs. Ticknor & Co. published on Dec. 11, 'Imperial Germany,' a critical study of fact and character, by Sidney Whitman. This book deals with some characteristics of Germany as a nation, socially, politically, and intellectually, passing in survey over the historical development, and showing the elements by which German unity has been achieved, and especially noticing the play of the ideal element in the process. The growth of the Hohenzollern power and the characteristics in its more prominent personages which have gone to form the grit of the Prussian nation, and finally to make it supreme in Germany; the condition of the army and the leading influences that have combined to make it what it is, with

— A. D. F. Randolph & Co. will publish at once 'The Fisherman's Daughter,' by Florence Montgomery.

— The Christmas number of *Harper's Weekly*, issued Dec. 12, consists of twenty-four pages. It contains an interesting sketch of Christmas customs in Germany by the Countess von Krockow.

— The sumptuous new volume of 'Mendelssohn's Letters,' lately published by Ticknor & Co., has received many most favorable notices. Mr. Gladstone says, "To Mendelssohn I feel grateful for his works, and I have also had the pleasure of hearing him play, some thirty or thirty-five years ago, in London. A few glances have shown me that the book will afford me a most agreeable perusal." Sir George Grove, author of the 'Dictionary of Music,' writes, "You have made me most happy with your beautiful book, and by the dedication, which is more than I deserve." Georg Henschel, the *maestro*, says, "I am almost through with it, and cannot tell you how I enjoyed it, and how splendidly the selections are made, and altogether how thoroughly you have succeeded in making the book highly interesting from beginning to end." Mendelssohn's eldest daughter says, "How charming the sketches are, and how very well done! I like every thing in and about the book, and personally enjoy it immensely. The letters read quite as if they had been written in English." And Robert Browning writes, "While I sat preparing the paper whereon to write, came the very book itself, — the dearest of books, just now. The best way will be to thank you at once, and be certain of finding plenty more to

thank you for when I have read what will interest me more than any thing else I can imagine in the way of biography."

— The English lady who writes under the pen name of 'E. Nesbit' has just made a collection of her later lyrics, which Longmans, Green, & Co. are about to publish. The book is called 'Leaves of Life.' The verse ranges from neatly turned and sharply pointed *vers de société* to serious poems of a high aspiration, frequently dramatic. Perhaps the most obvious characteristic of these poems is the sympathy the author reveals in them for modern moods of thought, and especially for the ambitions and revolts of the lowly.

— The late Lord Stanhope's 'Notes of Conversations with the Duke of Wellington,' just published in England by John Murray, will be issued in America by Longmans, Green, & Co. Lord Mahon was very intimate with the victor of Waterloo for the last twelve years of the Iron Duke's life, and he set down from day to day Wellington's table-talk, which is always interesting and often important. Wellington was as frank and as direct as Grant, and, like the great American commander, the Englishman was prompt to praise his chief adversary. Besides giving us Wellington's opinions of Napoleon, of Talleyrand, of his own army, and of the comparison of himself to Marlborough, Lord Stanhope's book abounds in quotable anecdotes.

— An extra number of the Riverside Literature Series (published monthly by Houghton, Mifflin, & Co., Boston, at fifteen cents a number) has just been issued, entitled 'Scenes and Dialogues from the Writings of Harriet Beecher Stowe,' by Emily Weaver. The number contains selections from 'Uncle Tom's Cabin,' 'The Minister's Wooing,' and 'Old Town Folks.' The dialogues are well adapted for private theatricals, and are also especially suited to take the place of readings or recitations in school exercises. The same firm now have ready a new edition of Andrews and Stoddard's 'Latin Grammar,' revised by Professor Henry Preble of Harvard University.

— The *Publishers' Weekly* states that on the 29th of August next year the *Journal des Débats* will have been a hundred years in existence. Unlike other newspapers, its daily impressions are not numbered, so the reader looks in vain on the front sheet for evidence of its age. "Though founded in August, 1789, the *Débats*," so says the London *Athenæum*, "did not attain a leading place among French newspapers till some time after it had become the property of the brothers Bertin, who bought it in 1799." It has had an eventful career, and, as Lamartine wrote, its history during sixty years forms a part of the history of France. It is still regarded as a sort of stepping-stone or ante-chamber to the French academy on account of the large number of its eminent contributors who have become academicians. An historical account of the paper will be issued in celebration of its centenary.

— Houghton, Mifflin, & Co. will publish next February, F. Hopkinson Smith's new book of travel, 'A White Umbrella in Mexico,' with illustrations by the author. One of the chapters is given in the December *Century*, and another will appear in the January *Atlantic*.

— Mr. George Hannah, librarian of the Long Island Historical Society, addressed the Grolier Club, 64 Madison Ave., on the evening of Dec. 10, on 'Early Printed Books relating to America.' On Dec. 14 the Grolier Club opened an exhibition of the printed matter of which Mr. Hannah spoke, which will continue ten days. It was reported that work on the new club-house was progressing rapidly.

— The town of Dedham, Mass., has just issued a second volume of records, under the title of 'The Record of Baptisms, Marriages, and Deaths, and Admission to the Church, and Dismissals therefrom, transcribed from the Church Records in the Town of Dedham, Mass., 1638-1845; also all the Epitaphs in the Ancient Burial-Place in Dedham, together with the other Inscriptions before 1845 in the Three Parish Cemeteries,' edited by Don Gleason Hill, president of the Dedham Historical Society, and town clerk. Supplied by G. W. Humphrey, Dedham, Mass.

— George Forbes Kelly, 31 E. 17th Street, New York, has just issued the first series of 'The American Art Portfolio.' This is

practically the cream of the first two volumes of *The Art Review*, now out of print.

— Gen. Benjamin Harrison, the President-elect of the United States, makes this pleasant allusion to Gen. W. T. Sherman, in a recent letter recommending the new Ticknor illustrated edition of 'Marching through Georgia:' "I was delighted to see how perfectly the artists have succeeded in illustrating the text of a song that no soldier, except it be the great captain who led the march, ever tires of hearing, and he, I think, only because his modesty is as great as his leadership was dashing and successful. The portrait of General Sherman is very spirited and lifelike."

— Gen. Regis de Trobriand, the gallant veteran of a hundred battles in defence of the Union, now lives in New Orleans, on the retired list of the United States Army. He is much pleased with Lieutenant Dauchy's translation of his 'Four Years in the Army of the Potomac' (just published by Ticknor & Co., Boston), and writes to the publishers, "My work enters a new career, all rejuvenated to bring back in vivid colors memories of great things accomplished by our generation, and not to be forgotten by those who come after us. The translation is excellent, and I can but be grateful to Mr. Dauchy, who undertook the labor and carried it through so successfully, and to you who took so good care to present it to the public in such an elegant form."

— The *Technology Architectural Review*, issued from the Architectural Department of the Massachusetts Institute of Technology eight times a year, promises to give American students of architecture "some of the broad training in design that must form part of the only foundation upon which any successful architectural career can be built."

— 'John Ward, Preacher,' the brilliant novel by Margaret Deland, is in its fifteenth thousand. The avidity with which the public seized upon this book was almost equal to that with which it has devoured 'Robert Elsmere.'

— William Q. Judge, New York, has just issued Mme. H. P. Blavatsky's new book, 'The Secret Doctrine,' the purpose of which is to "lay before the thinking world so much of the 'hidden wisdom'" — that is, of a divine degree of knowledge possible to human beings under certain conditions — "as it is thought expedient to make known at present to men in general."

— John Wiley & Sons have in preparation 'A Technical Dictionary, which will define, as an Authority, All the Terms of Art and Industry,' by Park Benjamin; 'The Guide to Piece Dyeing,' by F. W. Reisig, a practical dyer and chemist, and giving specimens of his own color-work and 100 recipes for the same; 'Steam-Engine Design for the Use of Mechanical Engineers, Students, and Draughtsmen,' by Prof. J. M. Witham, late assistant engineer U. S. Navy; and a 'Treatise on Linear Differential Equations,' by Prof. T. Craig of the Johns Hopkins University.

— The 'Johns Hopkins University Studies for 1889' will be devoted to (1) 'Arnold Toynbee,' by F. C. Montague, fellow of Oriel College, with an account of the work of Toynbee Hall in East London by Philip Lyttelton Gell, chairman of the council; also an account of the Neighborhood Guild in New York, by Charles B. Stover, A.B.; (2-3) 'The Establishment of Municipal Government in San Francisco,' by Bernard Moses, professor of history and politics in the University of California; (4) 'The City Government of New Orleans,' by Judge William W. Howe; (5) 'The City Government of Chicago, with a Bibliography on Municipal Government in the United States,' by F. H. Hodder, instructor in history in Cornell University; (6) 'A New England Village Community, a Study of Wethersfield, Windsor, and Hartford,' by Charles M. Andrews; (7) 'The Study of History in France and Germany,' by Prof. Paul Fredericq of the University of Ghent, translated by Henrietta Leonard; (8) 'Federal Government in Canada,' by James G. Bourinot, clerk of the Canadian House of Commons; (9) 'Local Government in Wisconsin,' by David E. Spencer; (10-11) 'The Gilmer Letters, an Account of the English Professors obtained by Gilmer and Jefferson for the University of Virginia,' by William P. Trent, professor of history and English in the University of the South; (12) 'Higher Education of the People, a Series of Social

and Educational Studies,' by Herbert B. Adams of Johns Hopkins University.

—Charles W. Sever, Cambridge, Mass., announces a new and enlarged edition of 'Songs of Harvard.' It contains all the latest and most popular songs and glees sung by the Harvard Glee Club and students of other American colleges. The book has already run through three large editions, and has met with great favor wherever introduced. Of Stories from the Persian, 'Abdulla of Khorassan' and 'Ahmed the Cobbler,' published by the same house, and edited by Prof. F. J. Child, the Boston *Advertiser* says, "These tales are taken from Malcolm's 'Sketches of Persia,' one of the most agreeable books in the English language, though it seems scarcely to be known to the present generation of Americans. If the two tales herein preserved are a sample of the entire book, it fully deserves the high praise that Professor Child has given it.

—In the *Magazine of Art* for January (New York, Cassell & Co.) the frontispiece is a photogravure from a painting by R. Caton Woodville, called 'Saving the Guns at Mainward.' The opening article, by Cosmo Monkhouse, gives a sketch of [the young English sculptor, Alfred Gilbert, and a portrait. 'Art in the Theatre' is the subject of the next paper, giving some illustrations from the work of some famous scene-painters. 'Salisbury Hall' is a description with pen and pencil of one of those picturesque old places found nowhere in such perfection as in England. The second paper on the 'Liverpool Corporation Collection' shows that shipping-centre to be a liberal patron of the fine arts. William G. Rossetti has another paper on the portraits of his brother Dante Gabriel. 'Expressions in Drapery' is a carefully prepared paper by Annie Williams, for which studies by Sir Frederick Leighton serve as illustrations. A full-page engraving of Mr. Homo Thornycroft's statue of General Gordon, erected in Trafalgar Square, brings us to the notes, which are full.

—The romantic and picturesque side of 'Castle Life' in the Middle Ages' will be described by E. H. and E. W. Blashfield in the January *Scribner's*, with many illustrations from drawings by E. H. Blashfield; Gen. E. P. Alexander, president of the Georgia Central Railroad, and one of the most widely known railroad men in the South, will write of 'Railway Management'; Thomas Bailey Aldrich, editor of *The Atlantic*, will write of some bright memories of his birthplace, Portsmouth, N.H. (his paper, entitled 'Odd Sticks,' is the first of the series of final papers which replaces the feature contributed last year by Robert Louis Stevenson); Miss Sarah Orne Jewett, whose work has heretofore dwelt with New England character, will contribute a story in an entirely different field, describing the family life of a respectable Irish-American saloon-keeper; and Robert Louis Stevenson, who spent last winter in the Adirondacks, describes a series of remarkable adventures in that region. The time is in the last century, when the wilderness was almost pathless.

—The United States Geological Survey has just published Bulletin 47, an analysis of the waters of the Yellowstone Park, by Messrs. Gooch and Whitfield of Prof. F. W. Clarke's staff. The analyses seem to have been very thorough, and sufficiently numerous to make accurate generalization possible. Physicians will be interested in the fact that arsenic and lithia were present in appreciable quantities, while iodine was conspicuously absent, and bromine was rarely found.

—John Wiley & Sons have just issued a new and improved edition of 'The Principles of Thermodynamics, with Special Applications to Hot-Air, Gas, and Steam Engines,' by Robert Röntgen, teacher in the Polytechnic School at Remscheid; translated, revised, and enlarged by A. Jay Du Bois, Ph.D., professor of dynamic engineering in the Sheffield Scientific School of Yale College. Very considerable additions have been made to the present edition. The application of the calculus to the subject has been given with sufficient fulness, in the shape of additions to Chapters VII. and XVIII. All examples and formulæ are given throughout the work in both French and English units, and the steam tables of Zeuner are given complete, both in their original French units, and also

reduced throughout to English units. Many new examples have been added.

—Prof. David P. Todd of Amherst College, Amherst, Mass., has published a very useful pamphlet, 'Instructions for observing the Total Eclipse of the Sun, Jan. 1, 1889.' In a recent issue of *Science* we traced the course of this eclipse through California. It will be visible from northern California to Manitoba, the duration of totality decreasing from 1m 57s to 0m 12s. Valuable observations may be made by amateurs without the aid of elaborate instruments, and it is particularly for the use of this class of observers that these instructions have been compiled. Professor Todd desires them to make sketches of the entire corona, and of the corona near the north and south poles of the sun's disk; sketches of the outer corona; and observations of the duration of the total eclipse. The latter observation is particularly desirable at places near the limits of totality. Instructions to amateur photographers conclude the useful pamphlet. The author requests that drawings or observations of this kind be forwarded to him.

—The third number of the *Journal of American Folk-Lore*, which has just been issued, concludes the first volume. While the journal was originally not intended to appear at regular intervals, the large amount of available material, and the general interest in its contents, have made it necessary to issue it as a quarterly. The present number contains a valuable paper by Prof. Horatio Hale on 'Huron Folk-Lore,' which will be continued in the next number; descriptions of Onondaga customs, by De Cost Smith and W. M. Beauchamp, and several other papers on Indian lore. Mr. W. W. Newell publishes a collection of a number of English folk-tales as told in America. For the coming volume a number of interesting contributions are announced on Indian lore as well as on that of Europeans settled in America. Attention will be paid to a full record of publications on American folk-lore.

—With the recent publication of the sixth part of his 'Butterflies of North America,' Mr. Edwards has issued eighteen plates of that incomparable iconography within two years, which is almost exactly fulfilling the promise of the first part. Considering the special difficulties which have stood in his way, this result is very gratifying. The present part is a most interesting one, giving such full illustrations of every stage of *Anthocharis genutia* and *Neonympha areolatus* as to leave hardly any thing to be desired. The artists have taken such evident pains in the execution of every detail, that the truthfulness of the illustrations is almost self-evident. We miss in part the exquisite work that Mrs. Peart has done, for she was unquestionably without a rival among American artists in this class of delineation on stone; but her standard has induced such excellence in her followers, that, but for what had preceded, we should be inclined to call this perfection. Credit must be given Mr. Edwards for this, for such excellence comes only from demand and from persistent purpose. Western species of *Anthocharis* and *Papilio*, with the chrysalis of the former, complete the series. Thanks mainly to Edwards, the complete histories of nearly all the various types of Satyrids in our country are now very well known, — better known, indeed, than are those of Europe, where, from the greater diversity of forms in this group, the opportunities are very much greater.

—Prof. Robert T. Hill, in a recent bulletin of the United States Geological Survey, gives a very useful summary of the history of geological investigation in Texas up to the year 1886. The first part of his work treats of the history of surveys, describing those of European travellers — among whom F. Roemer's work is of special importance — first. Next the United States military reconnaissances and explorations are recorded, and a history of the attempts to establish a State geological survey is given. The second part treats in a concise manner of the results of these investigations, the foundations on which the present work is to be carried on. Professor Hill has worked hard to arouse interest in geological work in Texas, and it is a matter of congratulation that his endeavors have been successful. His own contributions warrant that the work undertaken under his direction will yield important results.

LETTERS TO THE EDITOR.

*Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

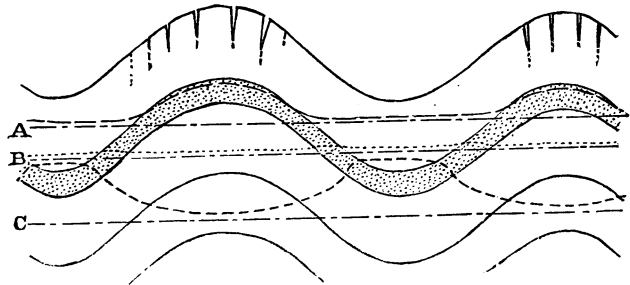
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Synclinal Mountains and Anticlinal Valleys.

In the recent reading of two very different books a statement is encountered that seems incomplete, and to a certain extent misleading, regarding the origin of synclinal mountains and their accompanying anticlinal valleys. The first book is an advanced monograph, entitled 'Les Formes du Terrain,' by La Noë and Margerie, in which it is stated (p. 150) that "finally a very remarkable consequence of erosion in regions of folded structure is to give rise to an ultimate arrangement of relief in which the original depressions are replaced by elevations, and *vice versa*." This generalization seems too broad. In the first place, the only ultimate form of land-sculpture is the base-level plain, down to which every surface must be reduced, whatever its structure, if time be allowed. Of this the authors are undoubtedly aware, and their term 'finale' should perhaps be rendered 'late' rather than 'ultimate.' But, in the second place, it is by no means essential that late forms developed by erosion on folded structures should present the inversion referred to. It is not a necessary or even a general result of progressive denudation, but simply a special result of a certain relative position of hard beds and the controlling base-level. For example: let the dotted stratum in the accompanying figure be a hard sandstone, while the other beds are soft shales and limestones. If the base-level be at *A*, a little below the arches of the hard bed but above its troughs, a late form assumed in the progress of denudation will be broad synclinal lowlands between anticlinal ridges (shown in long-broken lines, — — —). In this case the late form corresponds to the original structural surface. But if the base-level is at *C*, the opportunity for quick erosion that is afforded on the lower soft beds, when they are discovered by the breaching of the anticlinal crests, will soon cause the chief water-courses to abandon the synclinal axes that they had before followed, and excavate their valleys along the anticlinal axes. In this case the late form (shown by short-broken lines, — — —) consists of synclinal ridges or mountains, and there has been an inversion from the original structural surface. It may be added that this result is favored if the

region is first base-levelled at an altitude like *B* (the ultimate form in this cycle of development being shown in the dotted line . . .), and then bodily elevated so that the base-level falls to *C*; and this, I think (following suggestions from Gilbert and McGee), has been the case with the Appalachians.

The second book referred to is Hinman's 'Eclectic Physical Geography,' recently published. The Jura Mountains are taken as examples of young forms, in which the anticlinals are ridges: the Appalachians are chosen as examples of old forms, in which many anticlinals are worn down to valleys. By the time the Jura "have suffered erosion as long as the Appalachians, the present position of the mountains and valleys will have been reversed" (p. 261). It



seems pretty certain that when the Jura have suffered erosion as long as the Appalachians, they will be worn down flat; and whether an inversion of ridges and valleys will take place, or not, during this erosion, is entirely a special result of the relative attitude of hard beds and base-level, as above illustrated, and by no means open to unqualified prediction on general principles.

From finding the above statements concerning the origin of synclinal mountains in two books whose objects are so dissimilar, I have inferred that they represent a general belief, in which a special case is conceived to be a general one: hence this brief note on the subject. The question is a small one, and unnecessary in general accounts of geographic forms; but when the progress of denudation is alluded to, and early and late forms are distinguished, it is essential that the principles of classification should be clearly stated, it one would gain a full understanding of the systematic development of the surface of the earth.

W. M. DAVIS.

Philadelphia, Penn., Dec. 12.

Publications received at Editor's Office, Dec. 3-15.

- ADVOCATE, The. Vol. I. No. 1. St. Paul, Minn., Ramsey & Sons. 32 p. 4°. \$2 per year.
- AUSTEN, P. T. Chemical Lecture Notes. New York, Wiley. 98 p. 12°. \$1.
- BASTIAN, A. Allerlei aus Volks- und Menschenkunde. Vols I. and II. Berlin, E. S. Mittler & Son. 892 p., pl. 8°.
- Die Culturländer des alten America. Vol. III. Part II. Berlin, Wiedmann. 66 p. 8°.
- BOEHMER, G. H. Systematic arrangement of the List of Foreign Correspondents, July, 1888. Washington, Government. 201 p. 8°.
- Additions and Corrections to the List of Foreign Correspondents, to July 1888. Washington, Government. 147 p. 8°.
- DAY, D. T. Mineral Resources of the United States, 1887. Washington, Government. 832 p. 8°.
- FREDERICK III., Emperor. Case of. Full Official Reports by the German Physicians and by Sir Morell Mackenzie. German tr. by Henry Schweig, M.D. New York, E. S. Werner. 276 p. 12°.
- HALF Hours in Science and Art. Vol. I. No. 1. Fostoria, O., Half Hour Publishing House. 8 p. f°. 50 cents per year.
- HOLDEN, E. S. Suggestions for observing the Total Eclipse of the Sun on January 1, 1889. Sacramento, Cal., State. 21 p. 8°.
- MUSEUM für Völkerkunde. Veröffentlichungen aus dem Königlichen. Vol. I. No. 1, October. Berlin, Spemann. 16 p. f°.
- NEUMAYER, G. Anleitung zu wissenschaftlichen Beobachtungen auf Reisen. 2d ed. Berlin, Robert Oppenheim. 24 p. 12°.
- NIPHER, F. E. Missouri Rainfall. St. Louis, The Author. 7 p. 12°.
- SAUNDEES, W. Insects injurious to Fruits. 2d ed. Philadelphia, Lippincott. 436 p. 12°. \$2.
- U. S. ARMY. Annual Report of the Chief of Engineers, 1888. Washington, Government. 341 p. 8°.
- U. S. NATIONAL MUSEUM. Proceedings of the, 1887. Vol. X. Washington, Government. 771 p. 8°.

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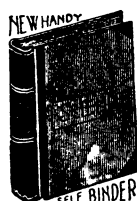
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